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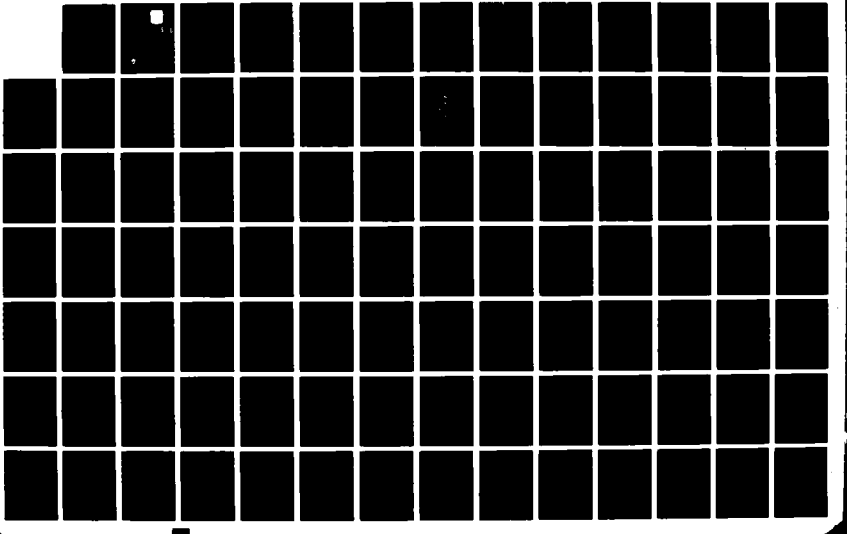

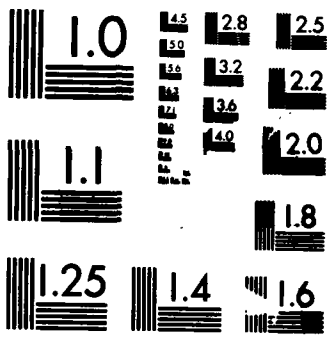

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STUDY PROJECT

ARTIFICIAL INTELLIGENCE: EXPERT SYSTEMS FOR CORPS TACTICAL PLANNING AND OTHER APPLICATIONS

BY

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23 MARCH 1987

US ARMY WAR COLLEGE, CARLISLE BARRACKS, PA 17013

USAWC MILITARY STUDIES PROGRAM PAPER

ARTIFICIAL INTELLIGENCE: EXPERT SYSTEMS FOR CORPS TACTICAL PLANNING AND OTHER APPLICATIONS

A Group Study Project

by

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ABSTRACT

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This Military Studies Project (MSP) differs from the norm in that it is a continuing multi-year project in which each year's effort is additive to work done in previous years. Providing primary focus for the project is an effort by the U.S. Army Communications-Electronic Command (CECOM) to develop an experimental expert system to assist Corps level planners in the formulation of tactical plans. Artificial intelligence as a discipline deals with the use of computer science to design "...systems that exhibit the characteristics we associate with intelligence in human behavior..."[1] Systems such as those that play games, diagnose engine problems, or organize cargo loads in ships are all examples of artificial intelligence. The sub-discipline of expert systems deals with computerized imitation of "...the reasoning or judgment process of human experts..."[2] CECOM's expert system for tactical planning draws its tactical expertise from the Army War College students that comprise the study group for this MSP. Computer scientists who have a long-term commitment to the CECOM project work with the study group "experts" to extract and understand what rules, guidelines, or thought processes the group uses to generate a tactical plan for a Corps operation. The computer scientist, known in the trade as a knowledge engineer, then takes these lists of information and converts them into computer knowledge which eventually become rules that will govern program output. In the heuristic environment of tactical planning, it would not be unreasonable to expect the finished expert system to contain between twenty and fifty thousand such rules. The multi-year approach to the project is driven home by the recognition that "A hand-crafted expert system...might have twenty rules after the first year of effort."[3] By working with CECOM's knowledge engineers, participation in numerous group sessions, TDY trips, and extensive reading, study group members developed an appreciation for some of the difficulties and opportunities associated with the use of artificial intelligence in its various military applications.

ENDNOTES

1. Avron Barr and Edward A. Feigenbaum, The Handbook of Artificial Intelligence, William Kaufman Inc., Los Altos, California, 1981, Volume 1.

2. Stephen W. Leibholz and Edward Ryan, "Expert Systems; Performance, Potentials, Promises, Problems", Government Executive, January 1987, p. 35.

3. Dr. Gerald M. Powell, MAJ Gary Loberg, Harlan Black, and CPT Martin L. Gronberg, "Artificial Intelligence and Operation Planning", Army Research, Development & Acquisition Magazine, Jan-Feb. 1987, pp. 27-29.

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CHAPTER 1

CONTEXT AND METHODOLOGY OF STUDY GROUP

As part of the effort to develop and field a Maneuver Control System, the Battlefield Artificial Intelligence Technology Branch of the U.S. Army Communications-Electronics Command (CECOM) is attempting to design an artificial intelligence program to assist corps level planners in the formulation of tactical plans. Working from a multiple-year research plan that was designed by CECOM in 1985, the authors of this report have attempted to provide the tactical expertise that CECOM needs to develop their product.

Artificial Intelligence and Expert Systems Defined

There are numerous definitions for artificial intelligence. As a discipline, however, it can be thought of as all of the efforts to use computer sciences and technologies to design "...systems that exhibit the characteristics we associate with intelligence in human behavior..."[1] Robots with "brains", a program that plays chess against people or against itself, programs that maintain inventories and reorder stock are examples of artificial intelligence. Expert systems is a relatively new sub-discipline of artificial intelligence and has to do with using computers to imitate the "...reasoning or judgment process of human experts..."[2] Designing a program that allows a computer to play draw poker is a relatively simple challenge for computer scientists in the artificial intelligence field. After all, the mechanical rules of the game are straightforward and odds of improving any given set of five cards are mathematically constant.

On the other hand, designing a computer program that will consistently win money against a table composed of professional poker players is an entirely different challenge. Following the rules and knowing the odds allows a machine to play a game normally associated with mental processes of humans and is illustrative of artificial intelligence. Incorporating betting strategies, the ability to guess what your opponents may do based on how many cards they drew, their personal mannerisms, how they played for the last hour, and the myriad other skills of a professional gambler moves into the realm of expert systems.

Expert Knowledge for the Expert System

CECOM's computer scientists are confident that available and rapidly developing technologies will allow them to build an expert system that through planner-machine interface will assist in formulating tactical plans at the Corps level.[3] However, the CECOM personnel are computer scientists, not tactical planners. They came to the United States Army War College and enlisted students to provide the "expert knowledge" required to develop Corps plans. Like the professional card player in the example above, War College students would attempt to explain the intuitive reasoning, mental shortcuts, rules of thumb, and equipment/unit/people capabilities that all go into tactical planning. This was the second consecutive year that students participated in the CECOM effort.

This year's effort was initially characterized by frustration on the part of the study group because it was not clear how one goes about encapsulating expertise nor did the group initially realize that an expert

system takes years to build. With the characteristic tendency of career soldiers to identify the task and accomplish it in short order, it was at first difficult to comprehend why this "expert system" could not be constructed in five months. As more was learned about how expert systems are put together, it became clear why eight to twelve years may not be an unreasonable timeframe in which to build a unique, tailor-made system. The requirements to identify experts and derive useful information from them is a patience trying, time consuming proposition.

The following is a lengthy extract from an article published by two computer scientists who built an expert system to assist in combatting terrorism. It explains precisely why the experience of the AWC study group is not atypical.

> "The task of eliciting from experts judgments that the system can use as rules is far more difficult and complex than originally anticipated. Experts, it appears, have a tendency to state their conclusions and the reasoning behind them in general terms that are too broad for effective machine analysis. It is advantageous to have the machine work a more basic level, dealing with clearly defined pieces of basic information that it can build into more complex judgments. In contrast, the experts seldom operate at a basic level. They make complex judgments rapidly, without laboriously reexamining and restating each step in the reasoning process. The pieces of basic knowledge are assumed and are combined so quickly that it is difficult for them to describe the process. When they examine a problem, they cannot easily articulate each step and may even be unaware of the individual steps taken to reach a solution. They may ascribe to intuition or label a hunch that which is the result of a very complex reasoning process based upon a large amount of remembered data and experience. In subsequently explaining a conclusion or hunch, they will repeat only the major steps, often leaving out most of the smaller ones, which may have seemed obvious at the time.

> Experts are not deliberately mysterious about the process of reasoning, nor are their analyses sloppy or incorrect. They simply do not state every single piece of information and every small component part of every judgment they make. Thus we discovered that the judgment the experts considered simple and basic were actually complex, often composed of many individual steps that could be elicited only by the annoying process of repeatedly asking them to justify each statement including the statements used to clarify previous statements. Obtaining the basic rules the system needs to mimic the reasoning process of the experts is a difficult and sometimes painful task.
>
> Attempts to extract rules from terrorist experts in the abstract simply by asking them to write all the rules they could think of pertaining to a particular domain did not prove successful for two reasons. First, experts don't usually think of their judgments as being based on a set of rules, and they have trouble putting their ideas into rule form. Second, the rules elicited by this method varied in level of abstraction but had to be broken down into their component parts, which is something the experts had not been required to do and normally were not accustomed to doing."[4]

Knowledge Engineers Capture Expert's Knowledge

Computer scientists who work with the experts to translate expertise into usable machine language are referred to as knowledge engineers. In their appraisal of expert systems, Leibholz and Ryan note that the knowledge engineer is vital to success of the effort.

> "Enter another critical element in the creation of an expert system; the Knowledge Engineer, a combination social worker, bartender, psychiatrist, prisoner-of-war interrogator, and computer scientist. Extracting expertise from an expert is the most difficult aspect of creating an expert system. It requires great skill at an interpersonal relations, a solid knowledge of artificial intelligence, and the ability to interrogate the expert and make sense (or nonsense) of his answers.
>
> The Knowledge Engineer works closely with the expert to understand the rules, heuristics, rules of thumb and facts used by the expert to solve problems in his area of expertise. The Knowledge Engineer then encodes the rules and heuristics in the knowledge base."[5]

Methodology for Dialogue with Knowledge Engineers

In order to have some realistic discussion medium and to generate tactical planning thought processes, CECOM provided to one element of the study group a Corps level tactical scenario. It contained a requirement to produce an OPLAN for a Corps offensive operation. This scenario was essentially a continuation of the USAWC CONEWAGO exercise. Attached as Appendix A is a copy of the CECOM scenario.

As members of the study group discussed how and why they would go about developing parts of the plan, the knowledge engineers in the interrogator mode would attempt to dissolve each action into its simplest parts. A seemingly small event in the planning process, such as selection of a divisional zone of action, could easily develop into long discussions. Waterman and Jenkins shared precisely the same experience when constructing their terrorism model.

> "We discovered that it was far more useful to elicit rules during or immediately after an actual event in which the experts were interested and wanted to discuss anyway. The event provided the stimulus for a lively discussion. During the discussion the experts were asked to offer their opinions or judgments or hunches about some particular aspect of the event. Then they were asked why they felt this to be true. This generally produced a train of rather complex judgments. They were asked to explain how they had made each individual judgment. Each of these produced a train of somewhat less complex judgments that were "pulled apart" by the interrogators, and the process was continued until the critical attributes were identified and basic rules about them articulated.
>
> This by itself was a major achievement. In effect, the extraction process compelled the experts to examine their own train of thought with an unprecedented degree of rigor.

> The first and most obvious result was the identification of the attributes of an event or group that were generally agreed to be the relevant things to examine. These were the bases for most judgments. The second result was the emergence of some rules about how these attributes interact."[6]

Relationship of 1987 Effort to Previous and Future Years

As noted earlier, the CECOM model is a multi-year effort drawing expert knowledge from a different set of USAWC student experts each year. While there is a continuation of effort, the continuation is primarily from CECOM's perspective. The base of knowledge captured by their knowledge engineers will continue to grow and eventually be translated into rules for the expert system they are constructing.

From the War College point of view, each new year a group of students involved with this MSP will essentially start over. If that sounds academically unattractive or negative, such is not the case. In fulfilling their expert role with CECOM, there is no requirement to "pick up where last year's group left off." All CECOM needs to add to its base is a group of experts providing insight into one of the myriad aspect of Corps level tactical planning. The specific subject may be the same as one covered last year or it may be entirely different. Either way the understanding and breadth of knowledge required by the knowledge engineer grows and the project makes progress.

From the study group participant's point of view, he or she gains an application for a technology that is the wave of the future, helps develop the Army's Maneuver Control System, and enhances his own analytical skills. Addressing this last point, Waterman and Jenkins noted:

"...the process itself, the extraction of basic rules, sharpened the experts' analytical skills. Regardless of whether these rules could ever be asssembled into a system that could in any way approach human reasoning in dealing with complex and ill defined subjects, being forced to articulate every step along the way to a problematic conclusion was a useful exercise for the experts. It made them more aware, and hence more critical, of their own reasoning; it caused them to determine closely how they arrived at conclusions; and it taught them to look carefully at the spaces between the steps they described. Also, it conditioned them not to overlook things that otherwise might have been ignored, especially in crisis situations when they would be compelled to make snap judgments without time for reflection."[7]

How Much Knowledge Has Been Engineered Thus Far?

At Appendix P is CECOM's summary of knowledge engineering sessions to date. For the next group of AWC students who undertake this project, it is imperative that they each read the summary. Whether they agree or disagree with the the observations is not critically important. What should be derived from the reading is an appreciation of the flow of thoughts and ideas that go through a planner's head and how to relate that to the knowledge engineer.

Differences from group to group or year to year will eventually be washed out when the knowledge engineer has enough understanding to formulate the rules that will run the system. If conflicting rules are entered or if the knowledge engineer did not really understand a particular concept, the program will not produce a near correct product and users will force the bad rule out of the system through iterative redesign.

Situation Assessment vs. Course of Action Generation

During the organizational phase of the CECOM-study group relationship, the study group of eight members was divided into two subgroups. These groups were titled the Situation Assessment group and the Course of Action Generation group. In reviewing CECOM's Knowledge Engeering Summary (Appendix B), the reader will see these two groups mentioned. In practice, both groups functioned as Corps tactical planners developing courses of action for a Corps operation. There was no cognitive "situation assessment" group input at any point in the 1987 MSP. However, members of each group addressed and identified themselves by these titles as will be seen in subsequent writings within this report. The following chapter discusses from an intelligence viewpoint the situation assessment model as it was profferred by CECOM.

ENDNOTES

1. Avron Barr and Edward A. Feigenbaum, The Handbook of Artificial Intelligence, William Kaufman Inc., Los Altos, California, 1981, Volume 1.

2. Stephen W. Leibholz and Edward Ryan, "Expert Systems; Performance, Potentials, Promises, Problems", Government Executive, January 1987, p. 35.

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4. David A. Waterman and Brian M. Jenkins, "Developing Expert Systems to Combat International Terrorism", EXPERT SYSTEMS Techniques, Tools and Applications, Edited by Philip Klahr and Donald A. Waterman, Addison-Wesley Publishing Co., 1986, pp. 115-116.

5. Leibholz and Ryan, p. 36.

6. Waterman and Jenkins, p. 116.

7. Waterman and Jenkins, p. 117.

CHAPTER II

THE SITUATION ASSESSMENT MODEL

Situation assessment is the analysis of descriptive information, from numerous sources (intelligence, operations, logistics, personnel, etc.) with the objective of determining the current situation and the development of plans. Situation assessment of the enemy is a continuous process requiring the full time effort of the intelligence community to develop an estimate of the enemy's most probable course of action and how that course of action will impact on friendly operations. This is the process by which intelligence is produced. Information is gathered, then integrated into an all-source product that provides an assessment of the situation and a projection of enemy intentions in sufficient time to allow the friendly commander to select the best plan or course of action to deal with the situation. This assessment provides information on the enemy, weather, and terrain throughout the command's area of interest. Intelligence analysis and predicting enemy actions is a deductive process that requires human interface; however, many of the steps in the intelligence production cycle can be emulated through the use of hardware and software in some type of expert system. With a computer model that represents the intelligence analysis functions it would be possible to produce useful intelligence.

A Procedural Model

The CECOM situation assessment procedural model consists of three sections:

a. Section one identifies the information requirements of the situation assessment process. In performing a Situation Assessment (SA) planners use descriptive information which has been: derived in the mission analysis process; derived from lower-level intelligence and terrain analysis; and provided in the situation reports on friendly forces. The input to the SA process includes the following: (1) perceived objectives of the enemy; (2) tasks and constraints for the operation; (3) situation map with friendly force, enemy force and terrain overlays; and (4) friendly and enemy force strengths and status.

b. Section two describes the output of the situation assessment generation process. The SA produces seven outputs: (1) relative strength estimates (point and time indexed); (2) relative mobility estimates; (3) key terrain; (4) tasks; (5) constraints; (6) enemy capabilities and intentions; and (7) enemy center of gravity.

c. Section three describes the situation assessment process in terms of the flow of information and products through the situation assessment sub-processes. Figure 1 depicts the flow of information through the sub-processes of the model.

The initial sub-process identifies those terrain features which will have a significant impact on the operation. Enemy forces of potential concern are then identified. Following this, terrain effects on the actions of identified enemy forces are analyzed to produce enemy capabilities and vulnerabilities. Enemy forces probable courses-of-action (COA) are estimated as the next step. These probable COA's are then evaluated

along with friendly forces and mission information to produce the following estimates: Relative Strength, Relative Mobility, Key Terrain and Enemy Force Center of Gravity.

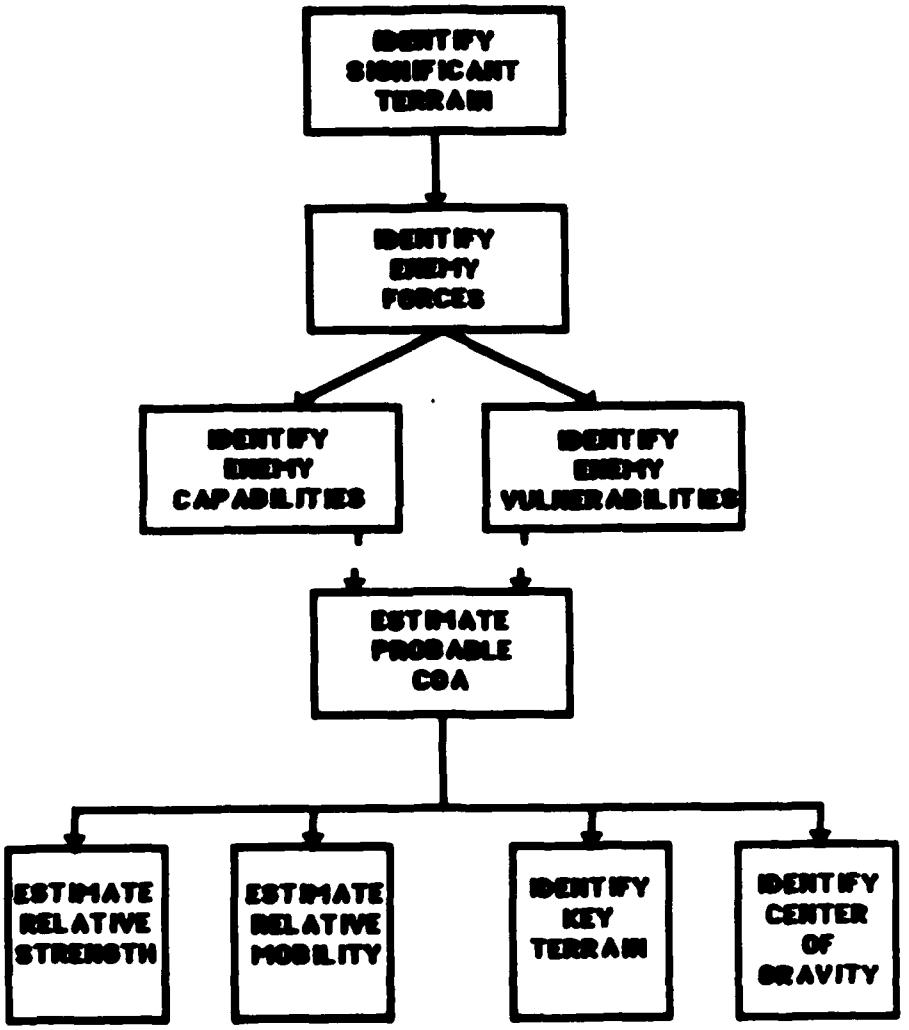

Figure 1

Assessment of the Model

The CECOM model serves as a start point for the situation assessment process; however, it does not adequately address the intelligence planning and management process. Intelligence planning in support of operational plans starts with a detailed and systematic approach to the analysis of the enemy, weather and terrain. The principal tool used to accomplish this is the Intelligence Preparation of the Battlefield (IPB) process. It portrays what enemy forces can and cannot do on the battlefield and the probability of the adoption of a specific course of action. It also is used to show the effects of weather and terrain on friendly forces and courses of action. Much of the information used in this process is in a data base form which facilitates the automation process and makes it easier to use in an artificial intelligence/expert system.

An Alternate Model

Figure 2 depicts a procedural model that portrays the intelligence battle planning and management process:

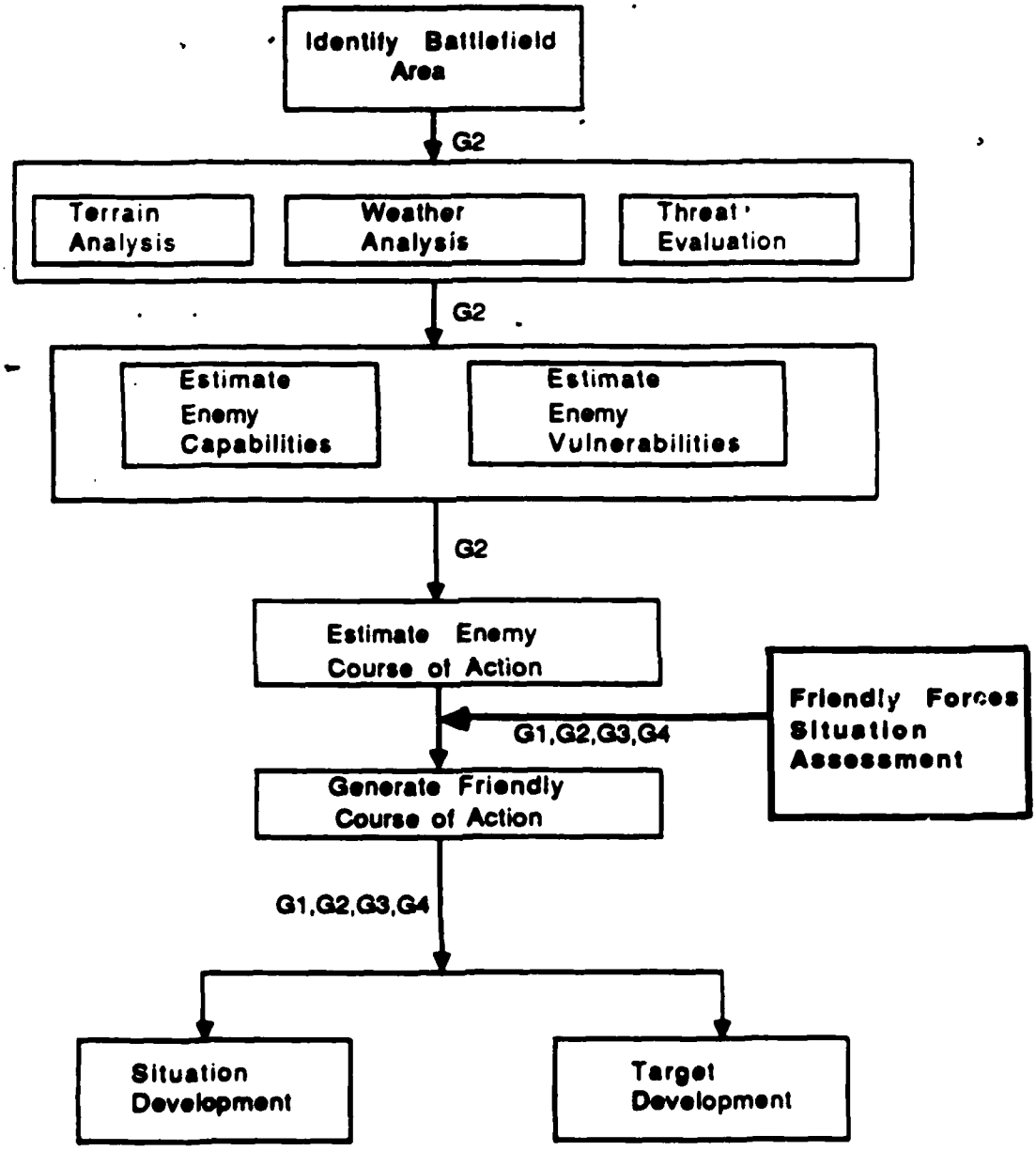
Identify Battlefield Area
G2
Terrain Analysis
Weather Analysis
Threat Evaluation
G2
Estimate Enemy Capabilities
Estimate Enemy Vulnerabilities
G2
Estimate Enemy Course of Action
Friendly Forces Situation Assessment
G1,G2,G3,G4
Generate Friendly Course of Action
G1,G2,G3,G4
Situation Development
Target Development

Figure 2

Step 1 - Identifying the Battlefield

The first step in determining the enemy situation is to identify where the friendly organization will be employed. This area is looked at to determine the area of operation, area of influence, and area of interest. The area of operations and area of influence are normally assigned by higher headquarters, while commanders determine their area of interest based on the mission, enemy, terrain and weather, troops available, and time (METT-T). The area of operations is that portion of the battle area necessary for the unit to accomplish its assigned mission. The area of influence is the geographical area in which the commander directly influences operations by maneuver or fire support systems under his command or control. The area of interest includes areas where planned or potential operations are to be conducted and areas occupied by enemy forces that could jeopardize the accomplishment of the mission. These areas contain the enemy forces, weather, and terrain about which the commander needs intelligence to make sound tactical decisions. They focus the intelligence operations on specific areas and enemy units.

Step 2 - Evaluating The Threat

Threat evaluation consists of a detailed study of enemy forces, their composition and organization, tactical doctrine, weapons and equipment, and supporting battlefield functional systems. The major effort is to determine how the enemy would fight if not restricted by weather or terrain. To accomplish the threat evaluation, information in the following areas would be desirable.

- Organizational
- Tactics
- Doctrine
- Composition
- Disposition
- Strength
  - Committed Forces
  - Reinforcements
  - Air
  - CER
  - Relative Strength
  - Logistics
  - Training
- Relative Mobility
- Templating
  - Doctrinal
  - Situation
  - Event
  - Decision
- Politics
- Economy
- Personalities
- Recent and present significant activity

Step 3 - Weather Analysis

Weather is analyzed in detail to determine how it affects friendly and enemy capabilities. Weather is looked at from a historical perspective as well as forecasted conditions. Because weather has a tremendous effect on terrain, terrain and weather are inseparable when conducting situation assessment. Data is required in the following areas to conduct an evaluation on the effects of weather:

Light data (BMNT, EMCT, EECT, EENT, Moonrise, Moon Set, percent illumination, etc).

Climate (Historical summary)

Precipitation

Ceilings and visibility

Fog

Temperature

Winds (Surface and Aloft)

Humidity

Weather forecast (same information as above). The effects of weather on each friendly and enemy course of action is looked at to determine which side it favors.

Step 4 - Terrain Analysis

Terrain analysis is focused on the military aspects of the terrain and their effects on friendly and enemy capabilities to move, shoot, and communicate. Information is required in the following areas:

Vegetation

Surface material

Surface configuration

Obstacles

LOC's (lines of communications)

Observation

Fields of fire

Concealment

Cover

Key terrain

Avenues of approach

Mobility corridors

Cross country movement (wet and dry)

Slope (Go-No Go)

Built-up areas

Air avenues of approach

Drop zones

Landing zones

Hydrology

Step 5 - Estimate Enemy Vulnerabilities

Consider the following factors:

Personnel strength	Training status
Morale/Health	Composition
Logistics	Disposition
Tactics	Combat effectiveness
Personalities	Past performance
Equipment status	
Mobility	

Step 6 - Estimate Enemy Capabilities

Based on all the previous information and analysis a list of enemy capabilities is developed. Each capability is analyzed to determine which is most advantageous to the enemy and how, if adopted, it will impact on friendly operations. Some capabilities available to an enemy are:

Attack	Delay
Defend	Withdraw
Reinforce	Employ NBC

Step 7 - Estimate Probable Enemy Course of Action

After a thorough analysis of the enemy, weather, and terrain it is possible to predict the enemy's most probable course of action. This prediction is based on all the information discussed above. This assess-

ment is a continuous process and attempts to determine: who, what, when, where, strength, advantages/disadvantages of each course of action, and center of gravity of the friendly forces that the enemy will focus on.

Step 8 - Generate Friendly Course of Action

Based on the assessment of friendly forces and enemy forces it is now possible to select the friendly course of action that will likely accomplish the stated mission. Friendly force course of action generation then leads to situation and target development. The correct situation assessment and course of action generation identifies: where to maneuver, shoot, jam, and communicate; when to maneuver, shoot, jam and communicate; what to maneuver, shoot and jam; what results to expect.

CHAPTER III

OPERATIONAL PROCEDURES AND GENERAL OBSERVATIONS OF THE SITUATION ASSESSMENT GROUP

As noted in Chapter I, the situation assessment group (SAC) and CECOM held a series of Knowledge Engineering sessions with the intent of identifying the knowledge and techniques experienced planner use when planning for military operations at the Corps level. This chapter will highlight the significant data which was repeatedly generated at each session.

The purpose of discussions between CECOM scientists and the SAG was to determine the rules for an expert system as a decision aid for a Corps planning cell. The group accepted as a general truth the idea that some aspects of computerized data would be of assistance to a planner by allowing him to have current data rapidly available to incorporate in the planning process.

Different Backgrounds, Common Themes

Throughout the knowledge engineering sessions, group members were encouraged to express their own experiences in the operational planning arena. As expected, these experiences varied, caused different values to be attached to different planning factors, and were frequently not precisely aligned with current doctrine. Nevertheless, it was generally agreed by the group that certain information would always be useful in tactical planning. The following list is not new:

1. Mission/Commanders intent

2. Current situation

Considerations affecting the possible courses of action:

(a) Characteristics of the area of operation

(1) Weather
(2) Terrain
(3) Other pertinent factors

(b) Enemy situation/capabilities

(c) Friendly situation/capabilities

(d) Relative combat power

Continuous Planning

The study group found that planning was a continuous process that required continuous maintenance and availability of data (i.e., METT) to maintain current courses of action based on the understanding of the situation. As the situation changes it may be opportune to implement a pre-determined course of action. In order to understand the situation, it is necessary to constantly maintain a data base on the enemy order of battle.

Importance of Enemy Information

Throughout each session the critical element of information that the planning group keyed on was the enemy. The enemy order of battle (EOB) needed to be known at all times. The EOB data that was required was unit identity, location, activity, probable courses of actions, command

relationship and doctrine (IPB/Templates). It was from this data that situational assessments were made and planning was allowed to be continuous by an "If-Then" process.

Group Consensus on Key Elements

After the first couple of sessions, it was clear that the same processes were used in the interplay of the members in the planning cell. It was clear that the combat arms members of the group generally agreed on how and when to employ certain types of units as a reaction to pertinent information (data). It was also clear that the combat support and combat service support members of the cell realized the importance and need for this information to improve the effectiveness of the complete planning process.

As a normal flow from information gathering comes the concept development or what may be called a "Scheme of Maneuver". This is expressed adequately in FM 100-5 as containing the essential elements of:

Who
What
When
Where
How
Why

During the thought process necessary for development of a scheme of maneuver, these six elements were constantly being answered by the cell. Although definitions may have differed among cell members, over a period of time agreement was made on word meanings.

The need to identify all or part of these six basic elements of a course of action became a normal part of every knowledge engineering session. Although many topics came up from time to time, the SAG believes that these items that would appear in any similar session made up of so-called experts.

CHAPTER IV

COURSE OF ACTION GENERATION

This study focused on Course Of Action (COA) generation within the planning cell in a Corps level environment. At this level, planning is a continuous process. Continuous planning is proactive vs. reactive and is long term. It is possible to characterize several dimensions of the environment within which planning is performed, including: the planning process, the planning function, and command post responsibilities related to planning. The study group concentrated on the planning process. For the purpose of this study, the planning process was subdivided into the following five categories: situation understanding, recognition, information gathering, concept development and plan maintenance.

Continuous planning requires the development and maintenance of alternative courses of action for contingencies. COA generation can be subdivided into three of the activities in the total planning process: (1) recognition, (2) information gathering and (3) concept development. All these activities collectively develop a COA, or alternate COA's for specific contingencies. These activities are then repeated for each contingency.

Task Recognition

Recognition is the stimulus which initiates action on one or more COA.

a. Source: It is the recognition that planning action is required to satisfy the potential operational requirement or contingency at some

time in the future. A number of potential sources for recognition were identified: statements of intent from command levels at least two levels about the planning cell; receipt of warning order from higher headquarters; and recognition that some new possibility exists or clarification of some previously fuzzy direction.

b. Content: There are potentially a number of data items associated with recognition which aid in bounding the operation. They are the Commander's intent, the Commander's concept, and an exact understanding of where we are now.

c. Mission Analysis: The doctrinal activities of mission analysis are included within recognition. At the completion of the mission analysis, the following information items have been developed and will be used in the remainder of the planning process. Tasks to be accomplished by the Corps during the ensuing operation, constraints under which the Corp is to operate, and understanding of the higher commander's intent must have been developed.

Information Gathering

Information gathering is the activity of determining the information required for COA development, acquiring this information if available, and producing this information if not available. In general terms, the intent of the information gathering activity is to determine the characteristics of the situation that can influence the Corps' capabilities to perform its mission regardless of which particular COA it develops. Information

gathering is characterized by interplay between functional areas within the plans cell and between the plans cell and other cells within the command post and functionally specialized units.

a. Information Requirements: Functional area representatives within the planning cell will obtain detailed baseline situation description for their functional areas. Information concerning the status of adjacent forces is required. Information concerning the status of joint forces is required. Information concerning the status of higher forces is required.

b. Information Development: What the operation must do must be defined. The future status of forces, both friendly and enemy, must also be forecast. The future capabilities of forces must also be defined.

c. Functional Area Interplay: The interplay between the functional area specialists within the plan cell assists in development of the baseline functional area description. This interplay will also serve to more precisely define the general concepts initially developed by the recognition activity.

Concept Development

This process commences upon receipt of a new mission and terminates upon completion of the selected COA. There is no clear break between the activities of information gathering and COA development. It is best understood as two activities that progress simultaneously, initially with an emphasis on information gathering but gradually changing to emphasize COA development.

CHAPTER V

APPLICABILITY OF ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEMS TO FUNCTIONAL AREAS

This chapter is a compilation of thoughts and opinions from various members of the study group as to the applicability of artificial intelligence and expert systems (AI/ES) in their functional areas. Each of the following sections represents the opinion of a single study group participant. In preparing these comment, group members were simply asked to provide thoughts and opinions on the subject. They were not bound to a given format or length.

Section A - Combat Arms

1. The tasking for this assessment directed that it be focused on "armor" and "operations" as "functional areas". Though there are a number of functional areas within the structure of the Army, armor falls under the major functional area as described in FM 100-5 of the "maneuver system". Operations, however, does not fit neatly into any single Army functional area, but rather is integrated into virtually all 17 functional areas as described in that same manual. For that reason, in this examination of the potential for the use of both artificial intelligence (AI) and its derivative ES, I will base my remarks on their applicability on maneuver systems within a combined arms operations environment. Further, I will focus the critical examination on the battle planning and command and control aspect only.

2. Opportunities

A. Battle Planning.

The differentiation between decision aid (assist) and decision maker has been discussed earlier in this study. Without completely reopening all the various arguments concerning that differentiation, I will merely state that at current and foreseeable states of the art of AI/ES technology, I prefer to restrict use to decision "assisting". With that restriction as the caveat, I strongly believe that aspects of AI/ES should be integral parts of battle planning within the maneuver system and virtually all other systems in the operations area as well.

Simple computer assisted plan development is already a technologically supportable option. Programs have been developed that will provide digitized terrain printouts on a computer screen, allow the placement and movement of units, provide simultaneous readouts of unit strengths, equipment status, fuel, ammunition and other detailed logistical information. Using a light pen, avenues of approach and other key graphics can be enscribed and calculations can be performed to determine the amount of time required for a given unit to traverse the routes, estimate the amount of resources which would likely be consumed, etc. In addition, massive amounts of data on other friendly forces, threat forces, weather implications, terrain conditions and logistical and other data can be rapidly collected, collated, and displayed to the decision maker. Though this information is greatly beneficial to the user, and will undoubtedly speed either a planning or command and control sequence it is not pure AI/ES technology.

What has not happened thus far in this scenario, is that no real problem or reasoning has occurred. That is not to say that it

cannot be done. The problem is to what degree should the reasoning or decision making inherent in the problem solving process be carried out? For example, can several different avenues of approach be enscribed as above and the computer queried as to the best one? Can an objective be given and the computer determine the avenue of approach which best fits the terrain and situation? The answer can, of course, be determined by the computer. It must be provided information concerning the unit organization, type vehicles, amount of terrain required for single and formations of vehicles, the trafficability, the speed, the enemy situation, etc. This must all be entered into the data base in sufficient detail for the "if-then" series of questions to be sorted and the logical result determined.

The problem in determining a solution in this scenario or any other is two fold. One is the multitude of information required in the database which must constantly be updated as all of the myriad factors change. The other is in knowing all of the questions which must be programmed into the logic sequence of the program. These questions, of course, diminish as the complexity of the problem is reduced.

b. Command and Control (C2).

In the area of C2, the military is probably substantially ahead of the power curve in developing AI/ES supportable systems. Again, the current uses are principally computer assisted, with little use of decision or reasoning functions in any existing hard or software.

Large computer generated battlefield displays, weapon and unit status displays, threat analyses and projected courses based on

current direction, speed of advance and other factors are used in a number of C2 facilities and/or simulations. Normally collocated with these displays is a comprehensive communications console that links the user to subordinate commands. All of these allow staffs to estimate, plan and recommend appropriate actions to commanders. Perhaps of more importance in this instance,they allow commanders to see situations rapidly and to direct the efforts of their subordinates with greater facility.

It again appears possible that with sufficient time, programs could be developed that would ensure that some level of decision making could be integrated into the process described above. That would allow the commander to dedicate less time to trivial task assignment and more time to devote to those items of greater import.

C. General.

In either the area of battle planning or the area of command and control, it appears that true AI/ES has the potential for integration at some level. The key question is with what degree of autonomy will the human commander allow the computers to collect and collate information, order the data into meaningful sets, develop and weigh various alternatives, determine the best solution and direct the efforts of subordinate units?

While the command and control of soldiers in combat, at any level, has never been without risk, the risk of directing an action which may result in the loss of life is hard to leave in the control of a non-thinking machine. Thus enters one of the emotional blocks towards develop-

ment of this technology, or at least the favorable consideration of its potential use to commanders.

Two potential solutions to this dilemna appear possible. The first is that technological development continue towards the development of computer programs with the capacity to learn and thereby think. The essential problem here is that presumably the computer ultimately converts everything entered into an algebraic problem which then requires some logic to determine the solution, even if the solution requires "thinking". Military decision-making often "depends on the situation", and on occasion the solution that best fits a situation is not necessarily logical, therefore the computer will never derive a correct but illogical solution. Though this non-computer scientist view may be somewhat simplistic, it nevertheless represents the second emotional block of computer based decision-making in the military arena. This block then impacts negatively on the first possible solution.

The second potential solution is to limit the directive authority of any automated system without human interface to review essential data and machine made decisions. This appears to be the most likely solution, but it too is not without problem.

The principal reason to computerize any process appears to be to allow the analysis of a large amount of data with fewer people and do it faster. A compile, run, stop, check, correct system which brings a commander into and out of the loop repetitively may very well take more time than existing command and control systems. Additionally, the system will require a number of trained computer programmers at each equipped

level of headquarters in sufficient numbers to allow the manning two or more shifts. The ever present requirements to harden, EMP protect, "Murphy" eliminate/reduce, and weatherproof the necessary hardware and software all create expensive solutions, both in terms of dollars and very critical combat soldier spaces.

With the potential pitfalls of each of the different approaches suggested here, the positive potential for AI/ES applications in both battle planning and command and control should override concerns. Battle planning can be improved and done with greater speed. As training of individual staff officers in the use of RB 101-999, the Staff Officer's Handbook improves their speed and efficiency, the training of those same officers and their commanders will improve both their speed and confidence in an AI/ES application.

3. Current Efforts.

The Maneuver Control System (MCS) as an integral part of the Air Land Battle Management System (ALBMS) is the principal on-going AI/ES potential effort in both the maneuver system and the operations aspects of other Army functional systems. The MCS will eventually allow direct commander to commander interface throughout the Army C2 structure with individual CRT's and consoles down to the level of some individual vehicle commanders for the issuing of orders and the transmittal of battlefield information. Though at the present time this represents only computer assisted battle planning and C2, again the potential for expansion to actual AI/ES applications exists.

On-going applications of AI/ES technology in both the maneuver system and with operations potential involve interactive simulations which exercise unit command posts at various levels. These simulations often create, develop and transmit responses or feeder information to senior and/or subordinate headquarters which force responses to certain tactical situations. Various simulations closely resemble operations in a real tactical environment, whether conducted in a mobile facilities or linked directly to the actual CP equipment of the training unit.

Synthetic Flight Training Systems (SFTS) and Unit Conduct of Fire Simulators (UCOFTS) are examples of potential fielded systems which have AI/ES expandable potential for further development for other aircraft and combat vehicle training. The rapidly expanding, extensively instrumented training centers such as the National Training Center (NTC) and the developing Joint Warfare Training Center (JWTC) are other areas with increasing potential for the use of such technology with their division slice of combat support assets.

4. Recommended Approach and Priorities.

A. General.

Two things have particularly struck me in this study with regard to the future of AI/ES in the maneuver and operations areas, whether in battle planning or command and control or in any other Army application. The first is that there appears to be little desire to focus the efforts of the computer and "knowledge" engineers that are apparently "in charge" of the numerous programs involved. It may be that the burgeoning numbers of

"information managers" in the various headquarters will take the challenge, or it may remain in the hands of the R&D or even combat developments agencies.

The second is that even within one agency's effort, the elephant is apparently being swallowed whole. Though this study group had considerable latitude to attempt to grip the problem, we were focused on the development of a course of action for a Corps level G3 planning cell. The dilemma being that the Corps operates at essentially the tactical level, but also interfaces at the operational level to some degree. The resultant problem is the sheer magnitude of data which is involved in describing the planning requirements and more importantly in defining the potential solutions.

B. Recommendation.

Above all is the recommendation that the on-going efforts to explore and expand the potential uses of AI/ES technology continue. I would strongly recommend that the efforts be coordinated by a single agency, which would have the relative power to direct the efforts of the myriad agencies currently involved. It might also be able to cull some of the efforts to refocus effort in areas achieving success and delete those that are merely spending money in nonsense programs.

Section B - Combat Arms

The initial military study project proposal described one of the desired results of the study as an examination of the effects of expert

systems/artificial intelligence on various "functional areas" such as Armor, Infantry, Operations, Personnel Management and others. While it is clear that the ultimate gains in this field will have differing levels of impact in the different disciplines of the Army, it is certainly not clear at this juncture that such differentiations can be made at levels further subdivided below those of combat, combat support and combat service support.

It is clear that AI/ES will have one major impact in the Combat Arms. The impact in the area of C2 and battle planning is to be gained in absolutely improved decision-making. With the support of AI/ES, better decisions, faster decisions or a combination of both are indicated. At present, it is unclear whether the better/faster decisions by the human are the principal goal of the researcher that this AWC study group interacted with or whether there is growing interest in the development of a pure decision-making capability for machines. In the area of purely improving the quality of timeliness of the decision,it is readily apparent that the rapidity and accuracy of data collection, its management and presentation to the decision-maker can all be vastly improved. This study group strongly believes that the ultimate objective in the AI/ES community should be to improve the decision-making capability of humans.

Once an expert system is designed that proves to be "friendly", commanders will be able to use this system as a planning guide in the decision-making process. Currently, however, the immaturity and newness of AI frightens or "turns-off" many military leaders. Applications in a military environment will naturally be difficult but the potential is here

today and will be improved upon with time, money and more expertise. Some applications that will be available to the commander as an expert planning aid could be tactical overlays, fire support plans, avenues of approach, plans for obstacles and barriers, main supply routes (MSR) and as discussed earlier in this paper, courses of action.

Section C - Military Intelligence

1. Opportunities.

Intelligence production methods have not kept pace with the advances made in collection systems and communications. Information collected by technologically-advanced sensor systems and sent and received over high-speed communications equipment is still processed individually as it is received by manually sorting, recording, and filing it. As the information flow increases more time is needed to identify, and organize the information needed to produce intelligence. To produce the intelligence the commander needs, when he needs it, these manual processing functions must be updated. Artificial intelligence/Expert systems have the potential to support efficient and timely intelligence production. This support will upgrade the ability of intelligence analysts to deal with the vast amounts of information that will be collected on the modern battlefield.

2. Current Efforts.

The All-Source Analysis System (ASAS) is currently being developed to provide integrated ADP support to intelligence analysis. The system will provide the means to process large volumes of combat informa-

tion and intelligence. It will use automation to route, correlate, file, display, process, and report intelligence in the battlefield environment. The intelligence analyst will be able to use this integrated system to support intelligence analysis and prepare intelligence estimates, reports, annexes, and other intelligence-related documents. This system will increase the analyst's ability to produce the intelligence the commander needs to plan and execute combat operations. It is feasible to integrate an artificial intelligence process into the intelligence production cycle, thus improving the overall process of situation assessment. ASAS capabilities will include the ability to interface multi-source and single-source processors and augment ASAS' capability to interface with other elements of the command and control system.

3. Conclusions and Recommended Approach.

For an artificial intelligence system to support intelligence operations it must be capable of performing many of the functions that normally require a sophisticated level of human interface, i.e., perception, understanding, learning, decisionmaking, and communicating. For the system to be successful it must be capable of emulating human actions in the following areas:

(a) Knowledge of Past and Present Events: Must be capable of tracking an event over time and to postulate its significance. This supports situation assessment, target development and collection management. The system must be capable of analysis so that it knows what it does not know and is capable of tasking systems to collect that information.

(b) Awareness of Current Situation: The system must be aware of the friendly (two up and two down) and enemy (two up and two down) situation, the areas of influence, interest, operations, and the significance of events impacting on the situation.

(c) Communication of what is and is not known and what information is needed to complete the unknown.

(d) Making or aiding decisions: The major problem is deciding which decisions are delegated to the system and which will require human action.

(e) Learning from results: The system must be capable of learning from the information it receives, understand the implications of events, information reliability, etc.

(f) Knowledge of Information Dynamics: The system must understand and evaluate information processing sequences and required, available expected, conflicting and irrevelant data.

Section D - Signal

I am confident that there are several applications which could greatly benefit from AI technology being applied. A few that come to mind follow:

- automatic data base management
- engineering modeling for mobile subscriber equipment (MSE), satelite communications, and other complex systems
- automatic selection of appropriate information to display to commanders or staff officers

What all of these applications have in common is that they deal with problems that, although massive and complex, are relatively easy to describe in quantitative terms. Rule based expert systems seem to be an excellent choice to manage some problems.

They act variously as filters for the human user - by only presenting information that meets selected criteria - or as combination computers and graphics generators to permit selection and display of engineeringly correct solutions to optimization of communications assets. The human operator can then assess each solution for adequacy, or more closely define the rules in-play to narrow options presented.

Section E - Transportation

Future applications in the transportation field offer much promise; two possible areas will be briefly highlighted - one pertaining to deployment of forces at the strategic level and one for the logistical employment of assets in the theater of operations. At the strategic level, the formation of the new Unified Transportation Command and its incorporation of the Joint Deployment Agency creates opportunities for the use of expert systems in the analysis of strategic mobility deployment options. The best mix of transportation modes at each node could be modeled using artificial intelligence. This would be constrained by the mission, troops and equipment available and time. Additionally, the new navigational aids provided by satellites would give the transportation operational planner real-time asset visibility (either ship or plane). Exact locations of each plane or ship moving in the system could be determined instantly. This information

would interface with a computer system using artificial intelligence to present to the transportation planner the best option available for time-phased force deployment of all units in the operational plan. After deployment and when all the logistical assets have been employed in the theater of operations, the same system as described before, could be used again; sensors on each truck, rail car, barge and helicopter moving in the theater army area would be linked to the transportation operations section in the logistical readiness center of the theater army support command. At this location, artificial intelligence would again come to play a major role in successfully determining the proper mix of surface assets to support the tactical mission.

Section F - Logistical Applications

1. Current Efforts.

In July, 1984, the Vice Chief of Staff of the Army requested an analysis of the cascading effects of the logistics planning factors, "using a LISP kind of programming." LISP is an acronym for List Processing, the language is designed to facilitate symbol, or word manipulation. LTG Robert Bergguist, commander of the U.S. Army Logistics Center, then initiated a feasibility study on the application of AI as it relates to the planning factors data base. This was the inception of AI into the field of logistics.

The Log Center had one year to complete their feasibility study. Resources were non-existant. No one at the Log Center had any knowledge of AI, no training aids were available, nor was there any AI software.

Sheer determination, operations research analysts, and computer scientists began their work with the use of a VAX 11/780 computer capable of running AI software. The Log Center was able to acquire LISP, OPS5 software which facilitates the construction of expert systems, the INGRES relational data base management system, a Golden Common LISP for IBM and compatible microcomputers and educational materials in the form of videotapes, textbooks, and articles on AI.

Opportunities came in mid-1984 for the Log Center's first application of AI. It focused on an extract of vehicle information from the Medium Truck Company's data base.

During 1985, the Log Center AI team developed a natural language query system for a relational data base management system. During 1986, they developed a knowledge - based AI system called PERKS, for Personnel Requirements Knowledge System. The objective of PERKS is to automate the identification of manpower requirements for combat support (CS) and combat service support (CSS) positions in units organized under TOE. Information for PERKS came from AR 570-2, Manpower Requirements Criteria, Tables of Organization and Equipment (TOE). What PERKS allowed the operator to accomplish was a determination by type (position and grade) and number of military personnel that are needed in a particular category for a particular unit.

In October, 1986 the Log Center AI team established an in-house AI program to produce knowledge-based systems for logistic analysis. Through the use of a Symbolics LISP processor and Intellicorps KEE (Know-

ledge Engineering Environment) expert system shell, they began construction of two different knowledge-based-systems.

One system will automate a portion of an Army manual which contains the rules regulating manpower requirements of Army units. The other system will be a true expert system, emulating a special problem-solving technique of a particular functional expert.

At this juncture the AI team of the Log Center developed an expert data retrieval system with a natural language interface. The TRUCKS system mentioned earlier, consists of an expert data retrieval system that responds to user-phrased English queries. The user can query the system to determine the effects of climate, terrain, or combat posture.

The Logistics Directorate (J-4) Organization of the Joint Chiefs of Staff presented a symposium on Artificial Intelligence Applications for Military Logistics. This symposium was conducted 17-19 March, 1987, in Williamsburg, Virginia. It provided an opportunity to discuss and compare continuing efforts and concepts for the future.

2. Opportunities.

The future of AI for the Log Center has begun. This year they will receive three Symbolics 3640 AI machines and various AI/Expert System software. With these resources they will evaluate how to automate CS and CSS and STAMMIS requirements into a prototype AI/Expert System advisor.

Opportunities are many with AI/ES and are only restrained by lack of funds. The Log Center programmed systems and research through 1997. By

1988 the first prototype of the CS/CSS and STAMMIS AI/Expert Systems advisor to assist War Room analysis will be delivered, tested and validated. They also will establish a research and training program with a local university to provide student assistance to the AI Center (at Ft. Lee) research and development. By 1989, intelligent interface with the microcomputer programs for the 82nd Airborne Division will be completed and tested. A truck transportation advisor will be developed to assist in organizing, loading, and route planning for convoys. In the 1990-1992 timeframe they plan to develop many small AI/ES microcomputers with a focus on Intelligent Computer Aided Instruction systems for use as maintenance/ diagnostics or system operations training. For the 1993 to 1997 timeframe they plan to test and field many AI/ES advisor products for unit planning factors development.

It appears that many agencies, within the military are going in their own separate direction. This is causing a reiteration of many of the problems encountered with AI/ES technology. An opportunity exists for the formation of an agency within the Army to direct energies, resources, experts and funding toward a consolidated effort in the area of AI; thereby causing functional areas to share experiences and lessons learned.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

Like Chapter V, this chapter is a compilation of the opinions and ideas of various members of the study group. The reader will note that several members were not enamored with the methodology used to structure the Military Studies Project. In only one case, however, does a group member express doubts about the utility of future applications of artificial intelligence. Given that the expertise provided by LSAWC participants is requisite to the construction of an expert system to aid in tactical planning at Corps level and given that with only one exception the participants see expert systems as useful and desirable, one must ask why the unhappiness with this year's efforts? The basic reason is that the group did not firmly understand its "expert" relationship with the CECOM knowledge engineers. Nor did it fully understand that they would not see an expert system produced this year. In preparing next year's participants, it is essential that they read Chapter I of this report and receive a short class (from someone other than a computer scientist) that discusses artificial intelligence and the construction of an expert system.

A U T H O R A

Throughout the effort, we gained a substantial appreciation for the complexity of capturing the information required to support development of an expert system. The dilemma that we face is that we are attempting here to not only describe, but to define human process which is more a function of the military art than that of a science. Other problems that led to a feeling of not being able to fully grasp the overall effort were:

1. Time Intensive: The effort often seemed to be time consuming. Capturing the human thought process results in seemingly endless exploration of the subject matter. About the time a subject seemed to be fully discussed, new information often surfaced and necessitated further discussion. As one would expect, the diverse backgrounds, different experiences, and individual points of view of the study group contributed to this.

2. No Clear Product: having no clear-cut road map to the final product results in a certain amount of anxiety on the part of the participants. Never knowing if a given train of thought will be beneficial to the effort.

3. Approach Unclear: The process of injecting human judgement and reason into the data collection and decision-making environment is extremely difficult to articulate. This difficulty, therefore, often yielded little concrete result. Once past the doctrinal school-house approach, the process of defining how the military planner thinks becomes vague and disconnected. Individual characteristics and personality traits result in different people thinking in different ways. To add to the complexity, group dynamics and interaction result in further perturbations.

4. Need to Emphasize Threat Process: Much like the attempt to define the knowledge of the planning process or the COA development process for the friendly forces, that portion of the process that pertains to the enemy must also be examined to the same degree.

5. Confusing Use of Terms: In the written efforts produced thus far by the CECOM engineers the use of computer jargon and standard doc-

trinal terminology have often been interposed to the degree where it might appear an entirely different subset of terminology has been created.

6. Unknown Relation To Other Efforts. The relationship between this effort and other related programs remains a mystery to the members of the study group. While this has no direct bearing on the group input, it does have impact on assessment of functional area aspects.

A U T H O R E

There is a definite need for and benefit to be derived from the use of expert systems for military applications. In wartime the loss of a key planner through the stress of combat, fatigue and even death, makes the use of artificial intelligence a real advantage. This system, though, must be more than a mere checklist; it must be sophisticated enough to manipulate logical chains of instructions between data and conclusions, while interacting with the user who provides feedback and coaching. This is required because the system can not subjectively discern between alternatives and it is not capable of thinking creatively or originally. Additionally, this is necessary because the proper use of military force is both an art and a science where intuition plays a major role.

Finding the military expert whose knowledge can be cloned is difficult. Having the expert available for a long enough time to interface with the knowledge engineer is also a difficult problem. The short-term approach of six months is not productive. USAWC students do not have the continuity necessary to put a dent in the project. They, like most

experts, have difficulty articulating the thought-processes they go through because many of their decisions are made in the subconscious mode. There are many different organizations within the Department of Defense who are working on artificial intelligence and no one is coordinating the overall effort. On a more positive note, it is imperative that the computer programmer/knowledge engineer consult the operational user (expert) first. This automatically eliminates the possibility for the user to make the allegation that the final product was a pipe-dream of some computer whiz-kid who knows or cares little about the military applications of the system in the field. It also builds mutual respect between the knowledge engineer and the expert.

Methodology for developing and integrating expert systems in the existing structure of this military studies project: The process must be looked at as a long-term conceptual effort. Rather than try to solve the whole effort at once, it must be narrowed in scope. The macro-approach of studying all the various nodes and decision points used in the Corps planning cell is frustrating to the "expert" and involves a ten to fifteen year project. Plowing new ground is not fun or easy for operators who normally work to final completion of a project. It is recommended that continued iterations of this project with USAWC students be concentrated in focus so as to see some progress at project termination other than an overall education and orientation in the field of artificial intelligence and the use of expert systems. For example, in situation analysis, one of the following factors of the mission, enemy, terrain, troops available, or time (METT-T) should be the focus for detailed study. That small part of the total project of assimilating all the data required could then be carried to completion.

A U T H O R C

Through my experience with this MSP I have gained an appreciable understanding of the proper approach to AI/ES technology.

Before one becomes involved in a new technology - training has to be of paramount importance. Therefore, before beginning the AI/ES technology, education is the first priority.

Since AI is such a diverse field of study, a limited field of study is recommended. As an illustration, I would not pursue AI for logistical support to COSCOM; I would begin at a much lower level, as did the Log Center at Ft. Lee, with the Medium Truck Company. They did not begin with a Transportation Battalion, but a small entity of that organization.

AI hardware and software must be available, learned and understood. Without the machinery, little to nothing can be accomplished. During this MSP, logistics was hardly mentioned and we were never exposed to any AI hardware or software. Knowing what a system can do with the "if-then", philosophy would be a quantum leap in the proper direction.

Once the training has been initiated and the machinery in place and an area of AI has been selected, the next priority is the functional area expert. Capturing human intelligence in a particular functional area creates a problem due to the short-term nature of our positions. The military must be willing to dedicate their functional area experts to AI research and development for periods of time long enough for the analyst to capture the necessary information required.

AI/ES technology should be managed at the civilian level rather than the military. If AI is to grow, it must be afforded the opportunity of research and development projects. The military fosters a short-term managerial base that is not condusive to long-range technology. If the option of civilian managed AI technology is not feasible, then the military must place more emphasis on acquiring uniformed computer scientists who are AI/ES trained and educated.

Lastly, more information must be communicated to the military, not just to an elite group, but to everyone. We must tell the story of AI/ES to the leadership of the Army, at all levels. We must be able to explain what it is, what it can do and what it is doing now.

A U T H O R D

After participating in this project, reading a selection of books, military reports and journal articles on Artificial Intelligence (AI); and after visiting the USASIGCEN and talking to the Commanding General and senior staff on AI, I am dubious about the future of AI to fullfill its advertised role as the panacea for Army decision-making problems.

In this section, I will present the basis for my doubts, identify what areas can effectively use AI technology in the near term, and suggest ways to improve current organizational structures controlling AI.

THE NEED. The "need" for AI is a top loaded one. The Defense Department, through the Defense Advanced Research Projects Agency (DARPA) has been supporting AI research for some 25 years. DARPA's charter to

"push" technology that seems to have Defense applications seemed to have begun paying off in the late 70's, when MIT, Stanford, and other respected universities began to talk about their success in developing revolutionary software that captured an expert's capability to solve problems.

The new techniques, referred to as "expert systems", were both new and interesting and soon a flood of papers on the potential applications of the technique were published.

Expert systems were going to help doctors diagnose illness and prescribe medication; engineers design better and more efficient products; students learn from machines that would replicate master teachers; and do all manner of other wonderful things, to include provide electronic tools for the military to help them deal with the expanding complexity brought about by the explosion in availability of all forms of information.

The hope was that we could use this technological edge to process information from our many sensors and data bases independent of human intervention. Artificial intelligence was going to let us literally "out think" our opponent. We could sense the enemy's plan faster, select the best course of action for our forces, (after war gaming several), and do it all with little human input.

As time passed, these goals began to work themselves into various Army acquisition plans as requirements. The defense industries turned on the afterburners to become part of the new wave of projects using AI. It was a hot field with lots of promise.

THE RESULTS: There is probably as much argument over the utility of AI as there is over the utility of light infantry. As the following examples show, it is just as emotional:

In the December 1986 edition of Defense Electronics, Gary R. Martins--who when working for the Rand Corporation had launched the ROSIE and ROSS expert systems--gives a scorching assessment of AI that concludes with a forecast that it may not survive to the end of this decade, but surely will be only memories reflected in "...meaningless buzzwords (e.g., expert systems) popping up now and then in low tech advertising slogans." [1]

Compare that view to that of Dr. Steven Andriole writing in the preface to Applications in Artificial Intelligence: he likens AI to a growth industry and states, "AI is an incredibly dynamic field and one that is likely to make enormous progress over the next five to ten years."[2] Dr. Andriole is a former employee of DARPA, where he directed the Advanced Cybernetics Technology office.

CURRENT ARMY ORGANIZATION. This is one of the things that causes me to be doubtful about the future of AI. There does not seem to be an organization that exists within the Army to exploit AI capabilities.

A U T H O R E

Artificial intelligence is fast becoming a part of everyday life. How much it can eventually do remains to be seen but only an intellectual simpleton can doubt that it can only grow in importance.

This year's MSP dealing with development of expert systems got off to a rocky start because neither CECOM, the project advisor, nor the USAWC participants realized that the USAWC participants did not understand construction of expert systems. Likewise, we did not understand that building on last year's project was applicable only to CECOM's knowledge engineers, not to the USAWC students. Our specific tasks were to expand the CECOM knowledge base and to learn about applications of artificial intelligence to military usage.

Further confusion resulted from the formulation of a "Situation Assessment" group that did nothing appreciably different from the "Course of Action" group. Regardless of the number of students assigned, I would recommend that all groups work on course of action development.

ENDNOTES

1. Gary R. Martins, "AI: The Technology That Wasn't", Defense Electronics, December, 1986, pp. 56-59.

2. Dr. Steven Andriole, Applications in AI, edited by the author, Petrocelli Books, Inc., Princeton, NJ, 1985, pp. xi-xiii.

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11TH CORPS (US)

BACKGROUND

In the hypothetical situation described, political and economic actions have led to greatly increased tension between NATO and the Warsaw Pact. Over a period of time, US reserve units have been activated and some regular army units have been reconstituted. In early 19__ a number of these units had been deployed to Europe.

By 1 December 19__, the United States had deployed the 11th Corps Headquarters, 4th Armored Division, 90th Infantry Division (Mech), 80th Infantry Division (Mech), 14th Armored Cavalry Regiment, and the 22d Aviation Brigade to West Germany. The theater commander assigned the 11th Corps and attached units to the newly formed Middle Army Group (MIDAG), which had been given responsibility for a sector in the vicinity of Hannover, West Germany. Prior to issuing his guidance and Operations Order, the Corps Commander directed the Intelligence Officer to review the topography of the area and the enemy organization.

Pact artillery preparations have commenced. Pact forces have vacated their assembly areas and are moving towards the international border. First echelon regiments have moved into pre-battle formations and are approaching 5 kilometers from the inter-german border.

TERRAIN OVERVIEW

The terrain within the 11th Corps (US) area of interest within West Germany is divided into two contrasting parts for which the Mitteland Canal can generally be depicted as the demarcation line. In the south are the Central Uplands with the Harz Mountains, the Lower Saxon Hills, the Weser Hills and the Westphalian Basin being the major land forms. To the north is a sandy northern lowland stretching to the west as far as the coastal marshes. Between these two parts, the Central Uplands and the Northern Lowland, runs the narrow fertile loess (loam) belt of the Hercynian Foreland.

Northern Lowland - The fundamental physical dividing line runs just north of Braunschweg, Hannover and Osnabruck. Going north, there is a change from loam to sand, from wheat to rye growing, from dense agricultural populations and industrial towns to relatively unpopulated heaths. Although the area had been glaciated, it lay outside the limits of the latest glaciation and the drifts are substantially leached, and the few remnants of terminal Moraines are greatly eroded. Large sheets of sand and gravel are predominant and these are divided into a number of separate sandy blocks (GEEST) by channels cut by melting glaciers. The growth of the vast peat bogs, especially in ill-drained depressions, was favored by the oceanic climate. In the coastal areas and the estuaries, however, fertile marshes are found. The kargest of the Geest blocks is the Luneberg Heath (Luneburger Heide), in general overview, the area between Celle and Hamburg, with the Weser drainage basin (glacial spillway) forming the western boundary of the Geest block. The poorest land has been planted with spruce. The sandy soil grows rye and potatoes and all of the valleys and swampy depressions provide pasture for cattle. Although well north of the 11th Corps sector, the Worthe terminal Moraine, which rises to over 500 feet and forms a hilly spine from northwest to southeast across the Luneburg Heath, is a noticeable terrain feature in the area. The Western Geest, to the west of the Aller and Weser Rivers, is lower and more level than the Luneburg Heath, and is split into many separate blocks by poorly drained depressions. The whole region lacks industry and the towns are small, with the exception of Oldenburg.

Hercynian Foreland Loess Belt - The Mittelland Canal links the west and east german canal system along the line of the Hercynian Foreland. This dry loess terrain was used by the great medieval highway following the Hercynian Foreland to the Elbe and beyond. Where routes out of the hills to the south emerged to intersect the highway, towns such as Hannover and Braunschweig grew up. The highway, railway and canal routes from the Ruhr to East Germany and Berlin today follow much of the route of the earlier highway. Portions of the Lower Saxon Hills to the south intrude into the loess belt as widely spaced escarpments standing as wooded islands in wide stretches of loess-covered plain.

The Harz - This massif stretches some 100 km from southeast to northwest. The slates and granites of this terrain feature form a rolling surface at 1600 to 2000 feet which in turn is overlookedf by the bare, windswept granite rocks of the Brocken (3747 feet) just east of the inter-german border. Streams from the Harz have cut narrow and deep-sided valleys. The rainfall and steep slopes have encouraged the preservation of forests with beech and oak below 1300 feet and spruce reaching up as far as the Brocken.

The Lower Saxon Hills - These hills are the outcrops of rock formations which extend to the north, west and southwest from the Harz. Towards the south the rocks are horizontal or gently domed, but in the north they are folded into a series of southeast to northwest trending arches and troughs. In the south, where the hills extend a short distance to the south of Gottingen, the rivers Leine and Weser have quite contrasting courses. Although the Leine is the smaller stream, the nature of the land has allowed it, using a rift valley, to open an 8 km wide passage. This is the route followed by the main north-south railway and autobahn between southern germany and the ports to the north. The Weser, on the other hand, has cut across sandstone. The narrow, winding valley created has traditionally not been used as a thoroughfare and no important towns are found along the Weser in that area. In the north the towns of Helmstedt, Salzgitter and Hildesheim generally define the transition to the loess belt. The folded rocks of the northern portion of the Lower Saxon Hills have eroded into escarpments of sandstones and limestones, with alternating small valleys of less resistant materials. The ridges are wooded with forests of beech or spruce and fruit trees cover the lower slopes. The loess-covered small valleys contain large villages of half-timbered houses set among the open farm fields. The Lower Saxon Hills project westward to, and in some cases beyond, the Weser River and

adjoin the Weser Hills.

The Weser Hills - These hills to the west of the Weser River are essentially a westward extension of the Lower Saxon Hills and have many of the same characteristics. Two notable features are two southwest facing escarpments, the Weichen Hills and the Teutoburger Wald, which define the northern and western boundaries of the Weser Hills. These hills push to the northwest, separating the Westphalian Basin from the Northern Lowland.

The Westphalian Basin - The Ruhr, the industrial heart of North Rhine-Westphalia, is probably the best-known feature of the Westphalian Basin. The heart of the basin, the area around Munster, has overlying clays which form the damp lowland of the Munsterland, which is broken only by occasional low ridges of sandstone or limestone. The basin's opening to the west results in high rainfall and ideal grazing country. The countryside has what has been called a very "English" appearance with cows grazing in hedged fields and large isolated farmhouses set in clumps of trees.

Urbanization - The Corps area of interest covers portions of three west german states. The percent of built-up-area in each of these is shown below:

Hesse	10 %
Lower Saxony	9.5 %
North Rhine-Westphalia	15%

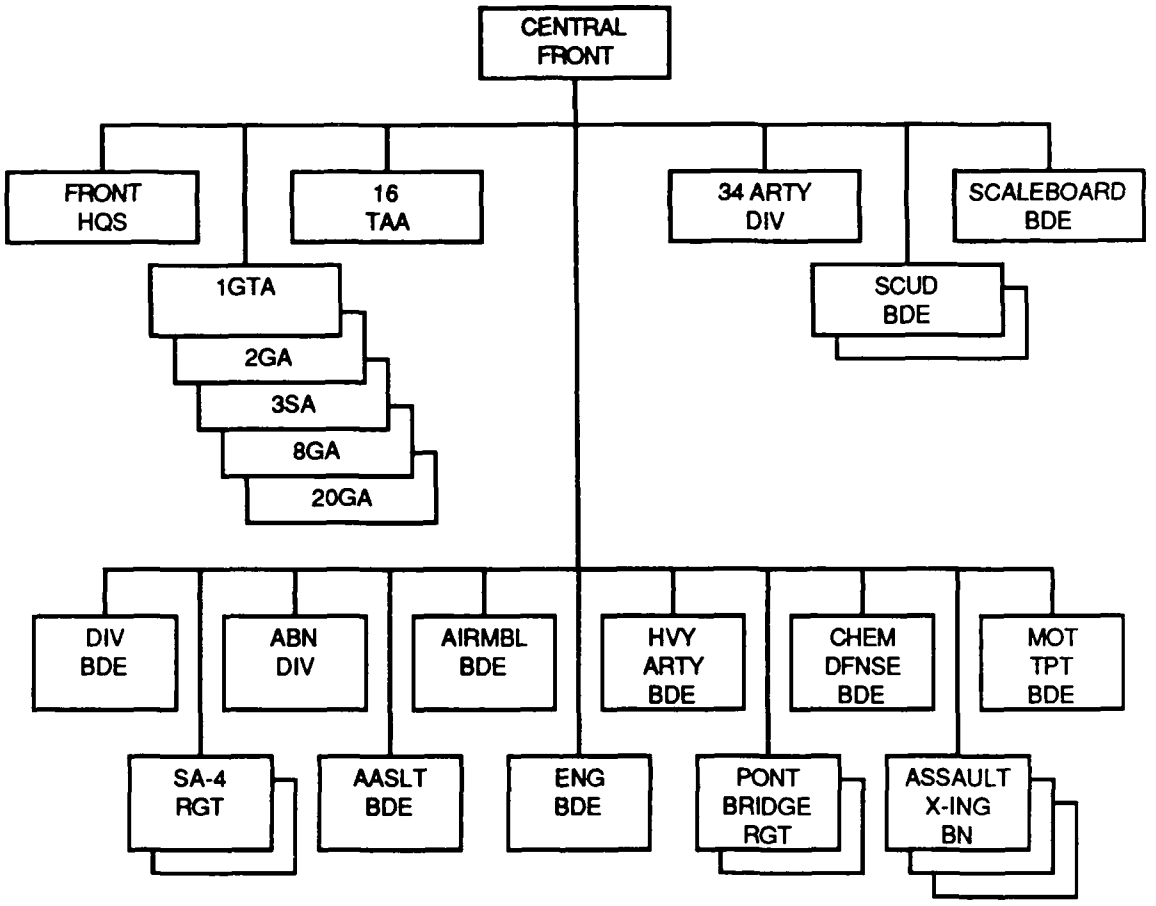
Of particular interest are the Ruhr (1155 sq km) and the Hannover area. The urbanization in the Hannover area has taken the form of growth along the E-8 autobahn toward Braunschweig in the east and Buckenburg in the west. Smaller cities such as Celle, Munster and Kassel also are growing in area and population. The Rhine-Ruhr area is converging with the Dutch Randstand. When this convergence occurs, a single gigantic urban barrier 300 km long, stretching down the Rhine from Bonn to the Hook of Holland, will be formed.

Rivers - The Weser River takes its name at the confluence of the Wera and Fulda Rivers at Munden. Flowing generally north, the shallow stream follows a winding course through hilly countryside until it pierces the Wiehen Hills escarpment at the Porta Westfalica at Minden and enters the Norther Lowland. The river has maximum flow in the winter, at a time of least evaporation, and a period of summer low water, and associated navigation difficulties. Drifting, or continuous ice, appears on the Weser at Minden for 14 days a year, on the average. North of Minden, the river is deep enough to provide a 1350 ton water route to the Weser ports.

The Rhine River in its northward passage attains a width of 3000 feet as it flows past Bonn. At Duisburg, in the Ruhr, there is one of the world's largest inland harbors. This harbor is the head of deep-sea navigation on the Rhine. Almost immediately after crossing the Dutch frontier at Emmerich, the Rhine divides into two parallel streams, the northern being called by the Dutch the Neder Ryn and later the Lek, and the southern the Waal. As it flows through the Dutch lowlands, the Rhine splits up again into the arms of its delta, a network of rivers and canals that give access to the great ports of Rotterdam, Amsterdam and Antwerp, and finally, at the Hook of Holland, to the North Sea.

ENEMY ORGANIZATION

Organization Structure (partial)



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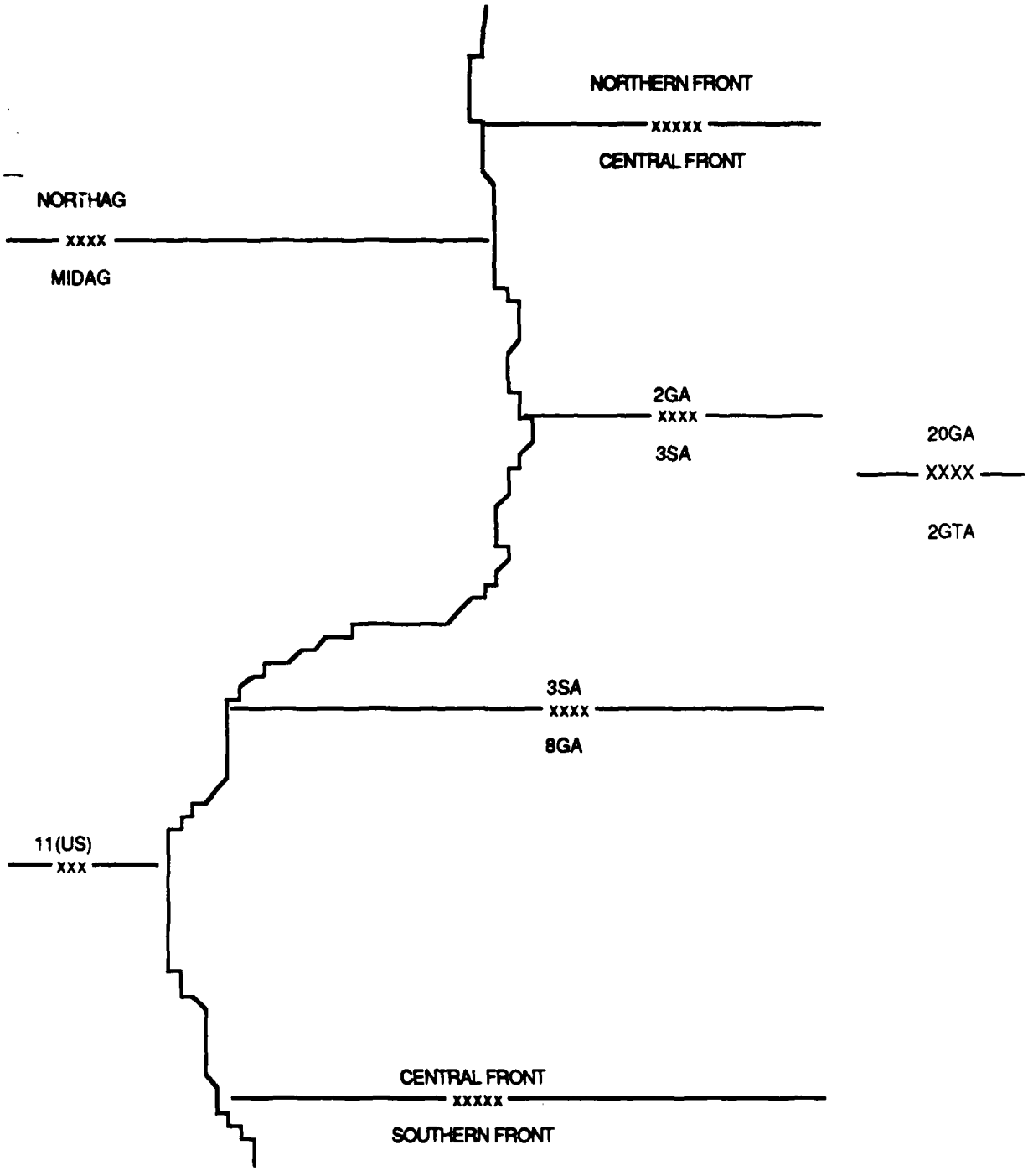
(see overlay)



APPENDIX A - Knowledge Acquisition Scenario

Order of Battle (partial)

CENTRAL FRONT

HQ, Central Front

...

2d Guards Army

16th Guards Tank Division

...

21st Motorized Rifle Division

HQ, 21st MRD

location:	PD8026

1st MRR

location:	PD7231
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BMP

2d MRR

location:	PD8125
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR60

3d MRR

location:	PD7123
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR60

4th TR

location:	PD8031
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80

94th Motorized Rifle Division

HQ, 94th MRD

location:	PD6222

1st MRR

location:	PD5713
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BMP

2d MRR

location:	PD5817
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR60

3d MRR

location:	PD5222
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR-60

4th TR

location:	PD5922
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80

207th Motorized Rifle Division

...

3 Shock Army

10th Guards Tank Division

HQ, 10 GTD

location:	PC6496

1st TR

location:	PC6097
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

2d TR

location:	PC5991
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

3d TR

location:	PC6184
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

4th MRR

location:	PC5987
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

12th Guards Tank Division

HQ, 12 GTD

location:	PC6274

1st TR

location:	PC5775
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

2d TR

location:	PC5978
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

3d TR

location:	PC5881
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

4th MRR

location:	PC6174
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

47th Guards Tank Division

HQ, 47 GTD

location:	PC9494

1st TR

location:	PC9190
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

2d TR

location:	PC8899
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

3d TR

location:	PC9494
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

4th MRR

location:	PC9085
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

7th Guards Tank Division

HQ 7 GTD

location:	PC6767

1st TR

location:	PC6065
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

2d TR

location:	PC6562
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

3d TR

location:	PC6271
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

4th MRR

location:	PC6670
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T80
apc-type:	BMP

3d Army Artillery Group

8th Guards Army

27th Guards Motorized Rifle Division

HQ, 27 GMRD

location:	PC4840

1st MRR

location:	PC3951
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BTR60

2d MRR

location:	PC4840
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BTR60

3d MRR

location:	PC4850
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64
apc-type:	BMP

4th TR

location:	PC3938
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T64

39th Guards Motorized Rifle Division

HQ, 39 GMRD

location:	PC6937

1st MRR

location:	PC6234
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BMP

2d MRR

location:	PC5724
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR60

3d MRR

location:	PC5844
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62
apc-type:	BTR60

4th TR

location:	PC6936
activity:	movement
equipment%:	100
personnel%:	100
tank-type:	T62

57th Guards Motorized Rifle Division

...

79th Guards Tank Division

...

1st Guards Tank Army

9th Tank Division

...

11th Guards Tank Division

...

20th Guards Motorized Rifle Division

...

32d Guards Tank Division

...

20th Guards Army

6th Guards Motorized Rifle Division

...

25th Tank Division

...

35th Motorized Rifle Division

...

ALLIED FORCES CENTRAL EUROPE (CINCENT) COMMANDER'S CONCEPT

CINCENT'S mission is the defense of the central region in the event of an attack by the Warsaw Pact. This concept calls for halting and destroying Pact forces attacking NORTHAG and MIDAG while threatening their base of operation in East Germany by securing the access route to Berlin. CINCENT will conduct a defense in depth to hold a line at least 100 km east of the Rhine River while NORTHAG, MIDAG and SOUTHAG prepare to counterattack, on order, to regain NATO territory and threaten the Pact base of operations.

This concept is based on the following forces and assumptions:

a. CINCENT will consist of three three-corps armies with an additional US airborne brigade deployed, and a US Armored Division and Separate Armored Brigade being deployed.

b. The threat main attack will be in the CINCENT center with the objective of securing and holding main crossing sites along the Rhine River north of the Ruhr with a subsequent objective being the ports of Antwerp and Rotterdam.

c. Threat forces will envelop the Ruhr prior to attempting its capture and may employ chemical weapons against defending forces in an attempt to preserve the industrial facilities.

d. Offensive air support will be extremely limited at least during the first few days. Local air superiority may be achieved for limited periods on about the fourth day.

The initial objective will be to establish and maintain a cohesive defense far enough forward to enable SOUTHAG to launch a counterattack towards Berlin. MIDAG will be prepared to conduct a supporting attack towards Magdeburg and the Elbe River. Expect the SOUTHAG and MIDAG attacks to be initiated following commitment of the Front's 2d echelon armies.

MIDDLE ARMY GROUP (MIDAG) COMMANDER'S CONCEPT

MIDAG's overall objective is assigned in Allied Forces Central Europe's (AFCENT) revised concept for the defense of the central region in the event of an attack by the Warsaw Pact. This concept calls for MIDAG halting and destroying Pact forces attacking in sector, and then conducting a supporting attack to facilitate the CINCENT main attack by SOUTHAG. MIDAG will conduct a defense in depth to hold a line no less than 100 km east of the Rhine River. MIDAG will conduct a supporting attack to facilitate SOUTHAG counterattack, on order, to regain NATO territory and threaten the Pact base of operations around Berlin.

MIDAG Commander's Concept is based on the following assumptions:

a. MIDAG will consist of three three-division corps with an additional US armored division and separate armored brigade deploying or deployed.

b. The threat main attack in MIDAG will be in the north with the immediate objectives of securing and holding main crossing sites and defensible terrain along the Weser River with a subsequent objective being the main crossing sites along the Rhine River north of the Ruhr.

c. Threat forces will envelop the Ruhr prior to attempting its capture and may employ chemical weapons against defending forces in an attempt to preserve the industrial facilities.

d. Offensive air support will be extremely limited at least during the first few days. Local air superiority may be achieved for limited periods on about the fourth day.

In compliance with CINCENT's overall main effort, the MIDAG initial objective will be to establish and maintain a cohesive defense far enough forward to enable SOUTHAG to launch a counterattack towards Berlin. MIDAG will be prepared to conduct a supporting attack towards Magdeburg and the Elbe River. Expect this supporting attack to be initiated following commitment of the front's 2d echelon armies.

MIDAG will defend with 11th Corps (US) in the north, 2d Corps (BE) in the center and 4th Corps (GE) in the south. The main effort will be in the 11th Corps (US) sector.

MIDAG COMMANDER'S GUIDANCE

Gentlemen, you have been issued, and have had an opportunity to review, OP PLAN 3-88. Our mission is to defend in zone, focussing on the destruction of Pact forces. I see our initial operations occurring in three phases. First we must defend against an attacker who can pick the time and the place in which substantial force in the form of maneuver units and firepower will be employed. We will face an attacker intent on shattering our forward deployed units and making a rapid thrust to cross the river and canal barriers in our sector as he carries his attack forward across the Rhine, into the low countries and the ports which are the heart of our logistical lifeline. In order to meet his objectives, I believe the main attack in the MIDAG sector will come on the axis Braunschweig, Hannover/Hildesheim, Bielefeld/Osnabruck, Munster and Wesel, skirting the Ruhr to the north. He is likely to conduct a strong secondary attack aimed directly at the Ruhr to the south of his main thrust, and will reinforce success if that attack is doing better than the effort to the north. His immediate objective will remain crossings over the Weser River, with subsequent objectives being crossings over the Rhine. He expects the Ruhr as a bonus. As you know, 11th Corps will conduct the main defensive effort in the northern portion of the MIDAG sector.

I expect that each corps will deploy a strong covering force on the best defensible terrain nearest the inter-German border and will present Pact forces with fierce and continuous battle from that border westward. In addition, once the border has been violated you will have to adjust your assets to fight both the close-in fight and the deep battle in your area of influence. Given our resources, focus on the direct destruction of combat power will take place in the close-fight. My priorities for the use of the combat power and intelligence resources in the deep battle are:

Nuclear and chemical delivery units.

Command and control.

Bridges, bridging equipment and other engineer equipment of all types,

Lines of communication and logistics facilities.

Portions of our area are heavily urbanized and the cover, concealment and barrier potential of the urban terrain will be used to the maximum to slow the Pact's forward momentum and disrupt their ability to conduct continuous operations, but any attempt at a completely static defense is likely to be enveloped.

I would like to stress the importance of preserving your command and the commands of your subordinates. I expect tenacity and that you will take calculated risks in the use of your combat power, but I am also willing to trade real estate for destruction of Pact forces. I believe we can stop the attacker to the east of the Weser River in the north and the Fulda and Werra Rivers in the south, and, if we do, it will make it easier for MIDAG to assume the offensive. If we cannot stop the Pact at the Weser, Fulda and Werra, then I will need your corps and subordinate commands as healthy as possible in order to stop him between the Weser and the Rhine. In any case, you must preserve your command, while inflicting maximum damage on the attacker. When we are able to attack to the east, I intend to make the main attack in the north with the 11th Corps. Although SOUTHAG will be making the main central region attack to our south, we must be capable of a strong supporting attack and should plan to cross the Elbe and strike toward Berlin.

Our defensive plans must stress the enemy's nuclear and chemical delivery capabilities and be based on the assumption that he will use these assets. In other words, our defensive concepts must survive the Pact's use of these weapons. On the other hand, I cannot guarantee that we will receive timely release authority for the use of friendly nuclear or chemical assets. Therefore, we must plan to survive the enemy's use, but we cannot be dependent upon friendly first use of nuclear weapons for the success of our plans.

OPERATIONS PLAN - MIDAG
(extract)

OP PLAN 3-8_ - Middle Army Group

Reference: Map, (as displayed on exercise room)

Task Organization: Annex A (Task Organization) (Amended Extract).

1. SITUATION. Enemy Forces. Appendix 1 (Order of Battle - Amended) (omitted - see section ENEMY ORGANIZATION).

2. MISSION.

MIDAG defends in sector, destroys attacking Warsaw Pact forces, seizes the initiative, attacks to regain control of NATO territory; and prepares to continue the attack into East Germany to defeat Warsaw Pact military forces and secure access route to Berlin.

3. EXECUTION.

a. Concept of the Operation. Annex C (Operation Overlay) (omitted - as displayed on exercise room).

(1) Maneuver. MIDAG conducts defense in zone, focusing on the destruction of Warsaw Pact military forces. Initially MIDAG corps defend forward along West German - East German border. Attacking Warsaw Pact forces halted to east of Weser, Fulda and Werra Rivers. MIDAG attacks to east to destroy Warsaw Pact forces in zone and restore West German - East German border. Prepare to continue the attack to the east to secure access route to Berlin. This operation will be conducted in three phases:

Phase I. MIDAG prepares to defend in zone with 2d Corps (BE), 4th Corps (GE) and 11th Corps (US) defending in sector. On order 2d Corps (BE), 4th Corps (GE) and 11th Corps (US) occupy sector and establish covering force along international border.

Phase II. Upon commencement of Warsaw Pact attack MIDAG defends in zone. Allows no penetrating Warsaw Pact forces west of the Weser River.

Phase III. MIDAG attacks to destroy enemy forces and secure NATO territory in zone.

(2) Fires.

(a) Air.

1. COMAAFCE initial effort will be to gain and maintain air superiority. During Phase II the majority of COMAAFCE capability will be directed to counterair operations. Second priority will be given to offensive air support (BAI/CAS) with air interdiction operations being given last priority.

2. Priority for air support to 11th Corps (US) during Phase II and Phase III.

3. Appendix 1 (Air Fire Support) to Annex D (Fire Support) (ommitted).

(b) Field Artillery. Appendix 2 (Field Artillery Fire Support) to Annex D (Fire Support) (ommitted).

(c) Air Defense Artillery. Appendix 3 (Air Defense Artillery Fire Support) to Annex D (Fire Support) (ommitted).

(d) Nuclear. Appendix 4 (Nuclear Weapons) to Annex D (Fire Support) (ommitted).

b. 2d Corps (BE).

(1) Defend in sector.

(2) Attack to secure NATO Territory in zone.

(3) Prepare to continue the attack to destroy Warsaw Pact forces in zone and to secure Harz Mountains and line Bernburg/Halle-Salle on Salle River.

c. 4th Corps (GE).

(1) Defend in sector.

(2) Attack to secure NATO Territory in zone.

(3) Prepare to defend NATO territory.

d. 11th Corps (US).

(1) Defend in sector.

(2) Attack to secure NATO Territory in zone.

(3) Prepare to continue the attack to destroy Warsaw Pact forces in zone and to secure Magdeburg and a bridgehead over Elbe River in order to secure access to Berlin.

...

4. SERVICE SUPPORT.

a. General.

(1) MSR (see overlay).

...

Annex A (Task Organization) (Amended Extract) to OPLAN 3-8_ MIDAG

MIDAG

HQ, MIDAG

...

2d Corps (BE)

...

4th Corps (GE)

...

11th Corps (US)

HQ 11th Corps (US)

80th Inf Div (Mech)
- HQ, 80th Inf Div (Mech)
- 1st Bde, 80th ID(M)
- 2d Bde, 80th ID(M)
- 3d Bde, 80th ID(M)
- 80th Cbt Avn Bde

90th Inf Div (Mech)
- HQ, 90th Inf Div (Mech)
- 1st Bde, 90th ID(M)
- 2d Bde, 90th ID(M)
- 3d Bde, 90th ID(M)
- 90th Cbt Avn Bde

4th Arm Div
- HQ, 4th Arm Div
- 1st Bde, 4th AD
- 2d Bde, 4th AD
- 3d Bde, 4th AD
- 4th Cbt Avn Bde

14th Armored Cavalry Rgt
- HQ, 14th ACR
- 1st Sq , 14th ACR
- 2d Sq, 14th ACR
- 3d Sq, 14th ACR
- Cbt Avn Co, 14th ACR

22d Aviation Bde
- 122d AH Gp
- 222d AH Gp
- 322d Cbt Avn Gp

11th Corps Artillery
- 311th Arty Bde
- 312th Arty Bde
- 313th Arty Bde
- 314th Arty Bde
- 1st Lance Bn
- 2d Lance Bn

11th Eng Bde
- 111th Eng Gp
- 112th Eng Gp

11th Signal Bde
- 111th Cmd Ops Bn
- 211th Rdo Bn
- 311th Area Sig Bn
- 312th Area Sig Bn
- 411th Sig Spt Bn

511th CEWI Gp
- 111th Mi Bn (Ops)
- 112th MI Bn (Tac Xplt)
- 113th MI Bn (Aerial Xplt)

...

Theater and Deploying Forces	Availability	Location
3d Allied Tactical Air Force	present	
1st Ground Attack Fighter Wing		
2d Dual Role Fighter Wing		
3d Tactical Airlift Wing		
4th Ground Attack Fighter Wing (CSS unit)		
9th Inf Div	D + 7	vic
HQ, 9th Inf Div		
1st Bde, 9th ID		
2d Bde, 9th ID		
3d Bde, 9th ID		
9th Cbt Avn Bde		
CAC, 9th CAB		
6th Arm Div	D + 4	
HQ, 6th Arm Div		vic
1st Bde, 6th AD	D+4	vic
2d Bde, 6th AD	D+6	vic

3d Bde, 6th AD	D+6	vic
19th Cbt Avn Bde	D+4	vic
64th Arm Bde	D + 3	vic
HQ, 64th Arm Bde		
315th Arty Bde	D + 5	vic

11th CORPS (US) COMMANDER'S CONCEPT

MIDAG's mission is the defense of the central sector of the CINCENT region in the event of an attack by the Warsaw Pact. This concept calls for halting and destroying Pact forces to the east of the Weser River, while preparing a counterattack to clear NATO territory. MIDAG must be prepared to continue this attack to the east with the dual purpose of securing Magdeburg and crossing sites over the Elbe River, and of supporting the CINCENT main attack to the south, which will secure access to Berlin and threaten the Pact base of operations in and around Berlin.

This concept is based on the following forces and assumptions:

a. 11th Corps (US) will consist of three heavy divisions and an armored cavalry squadron.

b. The threat main attack will be in the 11th Corps (US) center, south of the Mitteland Canal, with the immediate objective of securing and holding main crossing sites along the Leine River with subsequent objectives being crossing sites across the Weser River.

c. Although we have priority for air support, offensive air support will be extremely limited at least during the first few days. Local air superiority may be achieved for limited periods on about the fourth day.

The initial objective will be to establish and maintain a cohesive defense forward of the Weser River, with the intent of attriting Pact forces sufficiently to allow penetration of the Front's first echelon armies by our counterattack force. We must insure that Pact forces do not penetrate the defensible terrain along the Weser River. Expect the MIDAG attacks to be initiated following commitment of the Front's 2d echelon armies.

OPERATIONS PLAN - 11th CORPS (US)
(extract)

OP PLAN 3-8_ - 11th Corps (US)

Reference: Map, (as displayed on exercise room)

Task Organization: Annex A (Task Organization) (Amended Extract).

1. SITUATION. Enemy Forces. Appendix 1 (Order of Battle - Amended) (omitted - see section ENEMY ORGANIZATION).

2. MISSION.

11th Corps (US) defends in sector, destroys attacking Warsaw Pact forces, seizes the initiative, attacks to regain control of NATO territory; and prepares to continue the attack into East Germany to secure Magdeburg and crossing sites on the Elbe River..

3. EXECUTION.

a. Concept of the Operation. Annex C (Operation Overlay) (omitted - as displayed on exercise room).

(1) Maneuver. 11th Corps (US) conducts defense in zone, focusing on the destruction of Warsaw Pact military forces. Initially 11th Corps (US) divisions defend forward along West German - East German border. Attacking Warsaw Pact forces halted to east of Weser, Fulda and Werra River. 11th Corps (US) attacks to east to destroy Warsaw Pact forces in zone and restore West German - East German border. Prepare to continue the attack to the east to secure Magdeburg and crossing sites on the Elbe River. This operation will be conducted in three phases:

Phase I. 11th Corps (US) prepares to defend in zone with 80th Infantry Division (Mech), 90th Infantry Division (Mech), and 14th Armored Cavalry Regiment defending in sector, 4th Armored Division in reserve. On order 80th Infantry Division (Mech), 90th Infantry Division (Mech), and 14th Armored Cavalry Regiment occupy sector and establish covering force along international border.

Phase II. Upon commencement of Warsaw Pact attack 11th Corps (US) defends in zone. Allows no penetrating Warsaw Pact forces west of the Weser River.

Phase III. 11th Corps (US) attacks to destroy enemy forces and secure NATO territory in zone.

(2) Fires.

(a) Air.

1. COMAAFCE initial effort will be to gain and maintain air superiority. During Phase II the majority of COMAAFCE capability will be directed to counterair operations. Second priority will be given to offensive air support (BAI/CAS) with air interdiction operations being given last priority.

2. Priority for air support to 90th Infantry Division (Mech) during Phase II and Phase III.

3. Appendix 1 (Air Fire Support) to Annex D (Fire Support) (ommitted).

(b) Field Artillery. Appendix 2 (Field Artillery Fire Support) to Annex D (Fire Support) (ommitted).

(c) Air Defense Artillery. Appendix 3 (Air Defense Artillery Fire Support) to Annex D (Fire Support) (ommitted).

(d) Nuclear. Appendix 4 (Nuclear Weapons) to Annex D (Fire Support) (ommitted).

b. 80th Infantry Division (Mech).

(1) Defend in sector.

(2) Be prepared to attack to secure NATO Territory in zone.

c. 90th Infantry Division(Mech).

(1) Defend in sector.

(2) Be prepared to attack to secure NATO Territory in zone.

d. 14th Armored Cavalry Regiment.

(1) Defend in sector.

(2) Be prepared to conduct screening operations along 11th Corps (US) and 2d Corps (BE) boundary.

e. 11th Engineer Brigade (-).

(1) General:

(a) Priority of Engineer effort: 90th Inf Div (M), 80th Inf Div (M), corps rear area, in order.

(b) Priority of Engineer missions:

1. MBA: Countermobility in support of defensive positions in depth; Survivability in support of defensive positions in depth; Mobility operations in forward defensive areas.

2. Corps rear: Establishment and maintenance of LOC's; Survivability of comms facilities.

...

m. Reserve.

(1) 4th Armored Division.

(a) Be prepared to attack to secure NATO Territory in 11th Corps (US) zone.

(b) Prepare to continue the attack to destroy Warsaw Pact forces in zone and to secure Magdeburg and a bridgehead over Elbe River.

4. SERVICE SUPPORT.

a. General.

(1) MSR (see overlay).

...

Annex A (Task Organization) (Amended Extract) to OPLAN 3-8_ 11th Corps (US)

11th Corps (US)

HQ, 11th Corps (US)

- 80th Inf Div (Mech)
  - 311th Arty Brigade
    - 2d Bn (203, SP), 618th FA
    - 2d Bn (203, SP), 619th FA
    - 2d Bn (155, SP), 627th FA
    - 2d Bn (155, SP), 628th FA
    - 2d Bn (155, SP), 629th FA
  - 111th Eng Gp (-)
- 90th Inf Div (Mech)
  - 312th Arty Brigade
    - 2d Bn (203, SP), 614th FA
    - 2d Bn (203, SP), 615th FA
    - 2d Bn (155, SP), 624th FA
    - 2d Bn (155, SP), 625th FA
    - 2d Bn (155, SP), 623th FA
  - 313th Arty Brigade
    - 3d Bn (203, SP), 618th FA
    - 3d Bn (203, SP), 619th FA
    - 3d Bn (155, SP), 627th FA
    - 3d Bn (155, SP), 628th FA
  - 112th Eng Gp (-)
- 4th Arm Div
- 14th Armored Cavalry Rgt
- 11th Corps Artillery
  - 314th Arty Bde
  - 1st Lance Bn
  - 2d Lance Bn

Corps Trp

- 22d Aviation Bde
  - 122d AH Gp
  - 222d AH Gp
  - 322d Cbt Avn Gp
- 11th Eng Bde (Corps)
- 11th Signal Bde
  - 111th Cmd Ops Bn
  - 211th Rdo Bn
  - 311th Area Sig Bn
  - 312th Area Sig Bn

411th Sig Spt Bn

511th CEWI Gp
- 111th Mi Bn (Ops)
- 112th MI Bn (Tac Xplt)
- 113th MI Bn (Aerial Xplt)

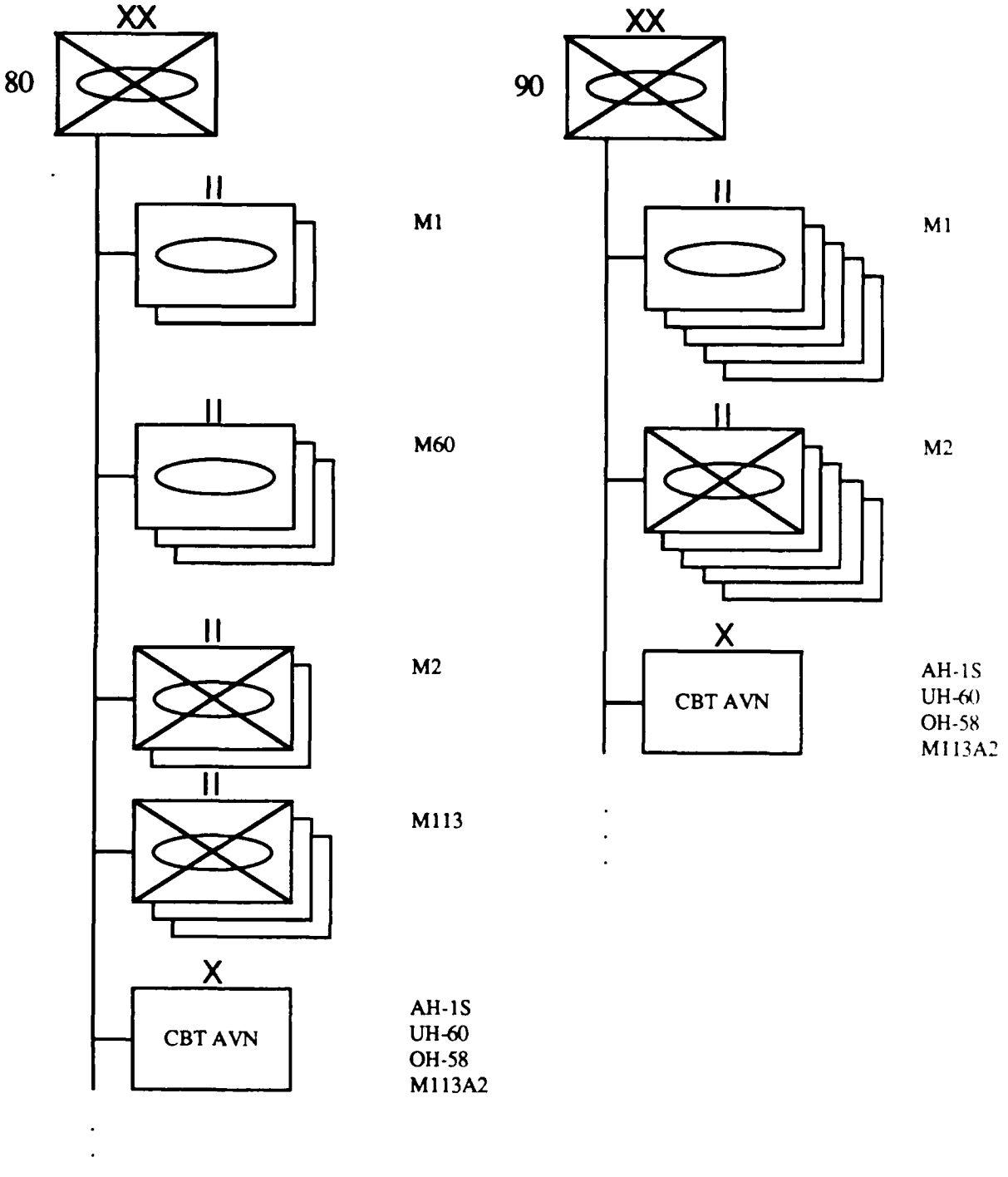
...

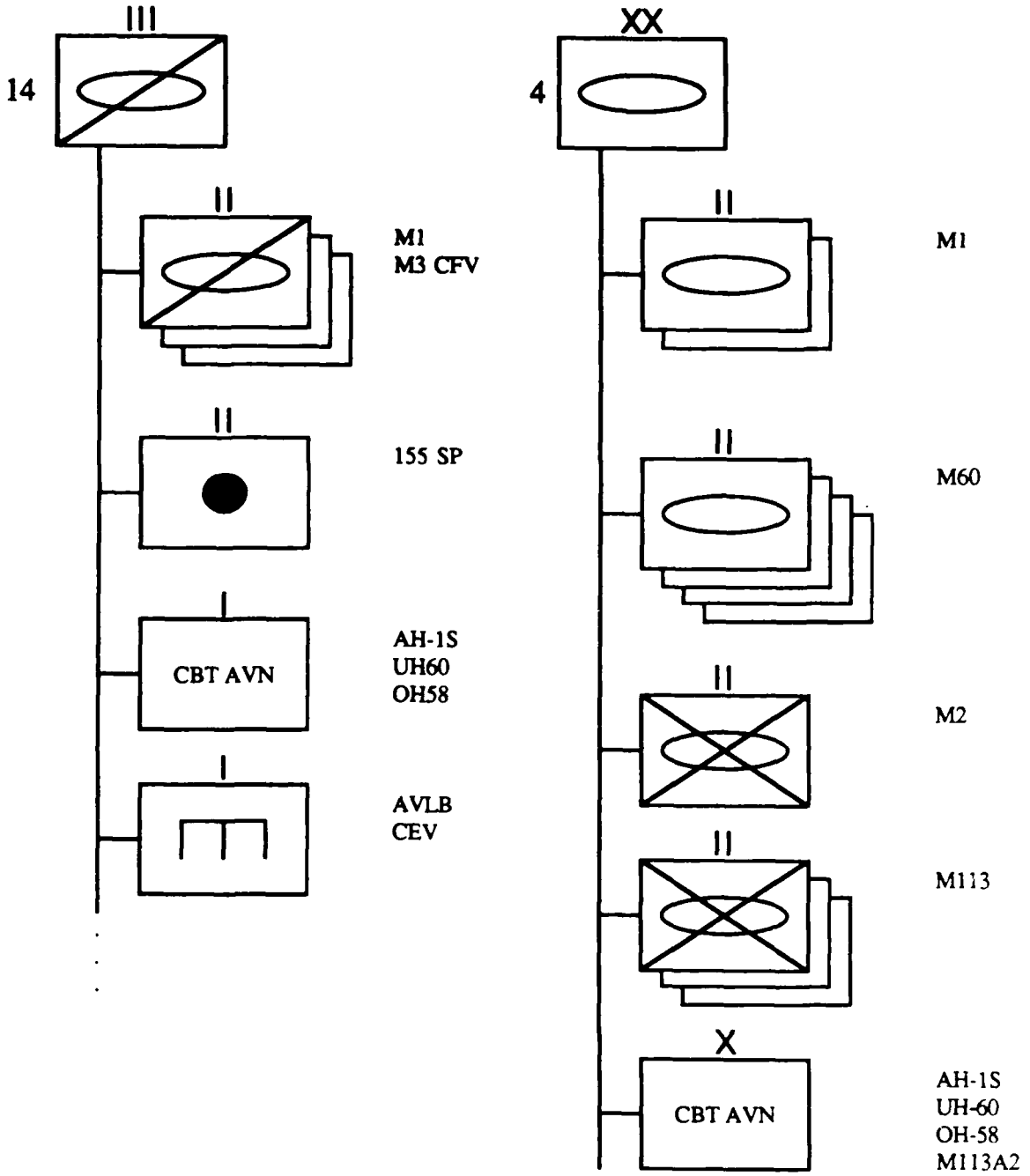
11th CORPS (US) COMMANDER'S PLANNING GUIDANCE

My discussions with Commander, MIDAG lead me to believe that we will initiate our counterattack to secure Magdeburg and Elbe River crossings between D+3 and D+4. We can also plan to receive control, effective D+3, of the 64th Separate Armored Brigade, which will be located in assembly areas in the vicinity of . I want you to look at the possibility of a separate supporting attack by the 64th to deceive the Pact concerning the actual main attack by the 4th Armored Division. Make sure we do not weaken the main attack too much in doing so.

I'm personally concerned about the possibility of a strong attack being conducted through the Belgian sector through Avenue of Approach . We need to be prepared to conduct a limited counterattack to restore the integrity of our defense if they are successful in penetrating our sector there. However, remember that we must retain suficient uncomitted forces to conduct the attack to secure Magdeburg.

11th CORPS (US) FORCE COMPOSITION

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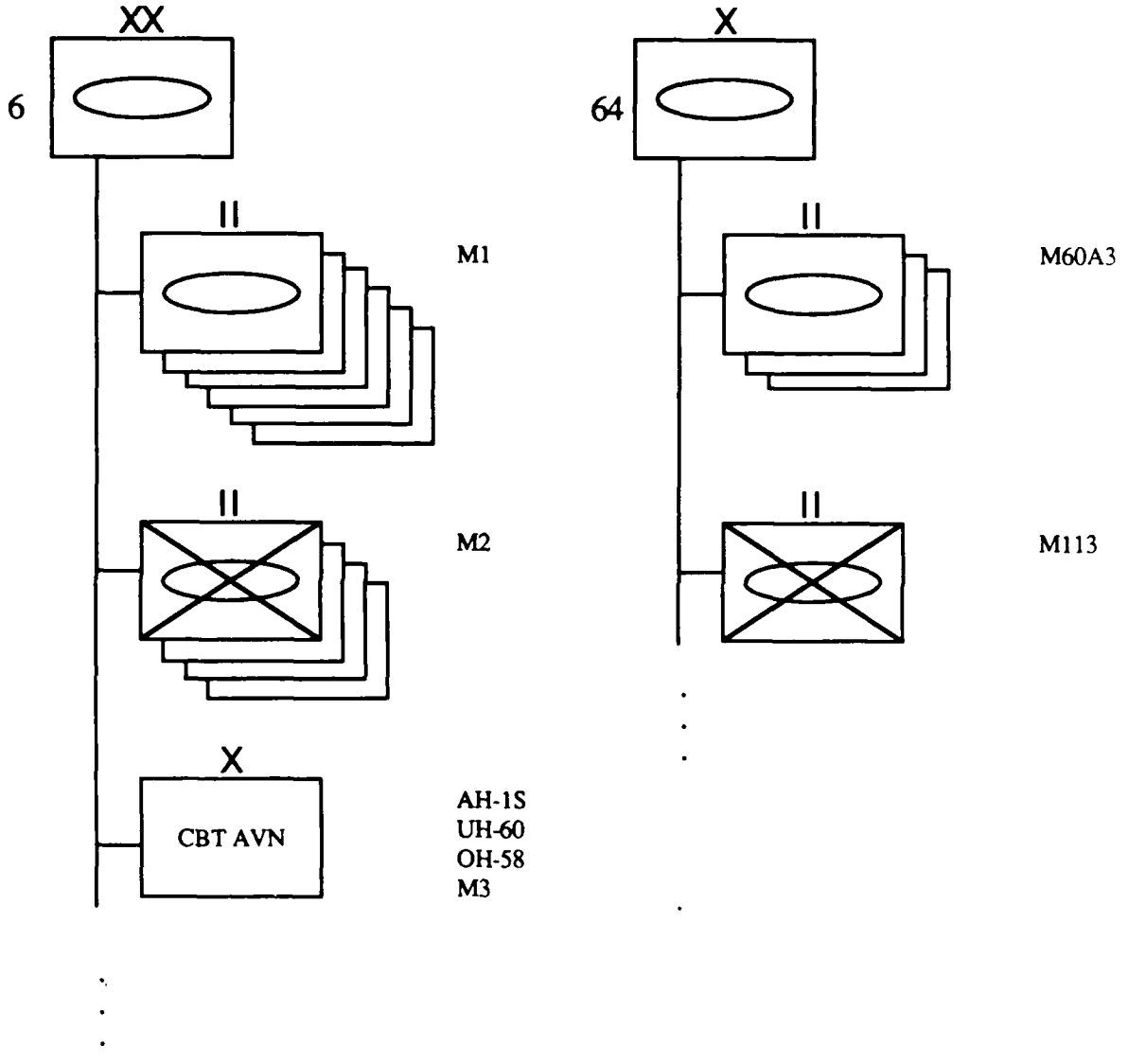
FOLLOW-ON FORCES (US) ORGANIZATION



APPENDIX B - Knowledge Level Description Summary

1. BACKGROUND. The U.S. Army War College (AWC) and the U.S. Army Communications-Electronics Command (CECOM) have jointly conducted a series of Knowledge Engineering (KE) sessions commencing December 1985. The intent of the joint effort was to identify the knowledge and techniques experienced planners bring to bear when planning for military operations at the corps command level. This MFR summarizes the results to-date of this collaboration. It does not recreate the flow of the sessions, or summarize the discussions that led to the development of the ideas presented. It does attempt to present a coherent description of the ideas developed.

2. LIMITING ASSUMPTIONS. A number of assumptions were made to limit the scope of this effort. The restriction to the corps command level has already been addressed.

2.1 Operational Environment. The study group will consider themselves to be officers in a plans cell of a heavy corps in a European environment. The corps is currently conducting operations in a mature theater. We are concerned with all plans cell activities which contribute to the development and maintenance of (alternative) Courses-of-Action (the terms "Concept", "Course-of-Action" and "COA" will be used interchangeably throughout the remainder of this document) for numerous contingencies. The group will be considering only the mental processes of the planners *as practiced* by the AWC participants. This final limitation means that this MFR does not necessarily reflect a doctrinal description of the planning process, but does reflect the accumulated experience of the AWC participants in performing the planning task in a variety of environments.

2.2 Long-Term Objectives. The CECOM and AWC objectives for this project overlap but are not identical. We are both concerned with developing a precise understanding of: 1) the information requirements of corps planners; 2) a course-of-action; and 3) the knowledge experienced planners possess which allows them to develop and maintain courses-of-action from information.

2.2.1 Additionally, CECOM is interested in formalizing the above understanding in computational terms. This will support future experimentation in automated decision aids for the planning function, with the idea of eventually fielding such aids as standard command post equipment.

2.2.2 AWC is also interested in forming estimates on the applicability of Artificial Intelligence/Expert Systems for the various functional areas.

3. THE PLANNING ENVIRONMENT. At the corps level planning is a continuous process involving the full-time efforts of a number of officers of the Corps Plans Cell, and the efforts of others (e.g., Commander, Chief of Staff, G3) on an as-needed or desired basis. It is possible to characterize several dimensions of the environment within which planning is performed, including: the planning process, the planning function, and command responsibilities related to planning.

3.1 THE CONTINUOUS PLANNING PROCESS. Continuous planning is proactive (vs reactive) long-term. The concept of continuous planning is not well understood or practiced. The process as described document refers only to the actions of planners, and does not refer to the actions of other staff officers providing information critical to the planning process. Continuous planning requires the development maintenance of alternative courses-of-action for contingencies. Course-of-Action maintenance modification of a course-of-action based on changes in the situation for which the course of action Course-of-action maintenance is not well understood. Continuous planning requires the maintenance courses-of-action for the current operation. This is required since these alternative courses of action focus as the operation is being conducted. In other words, it may become necessary to [illegible]

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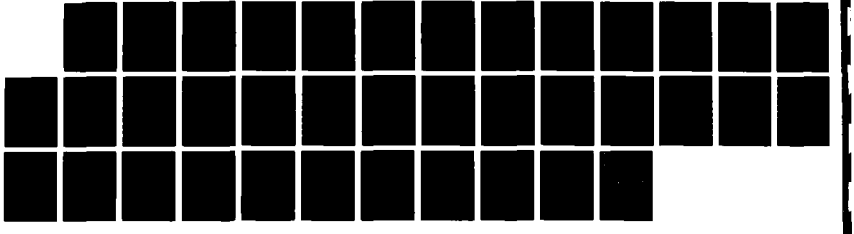
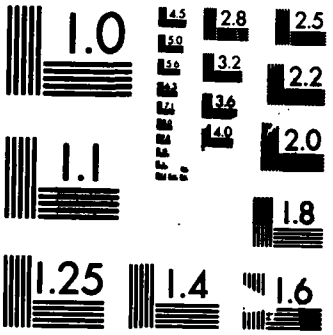
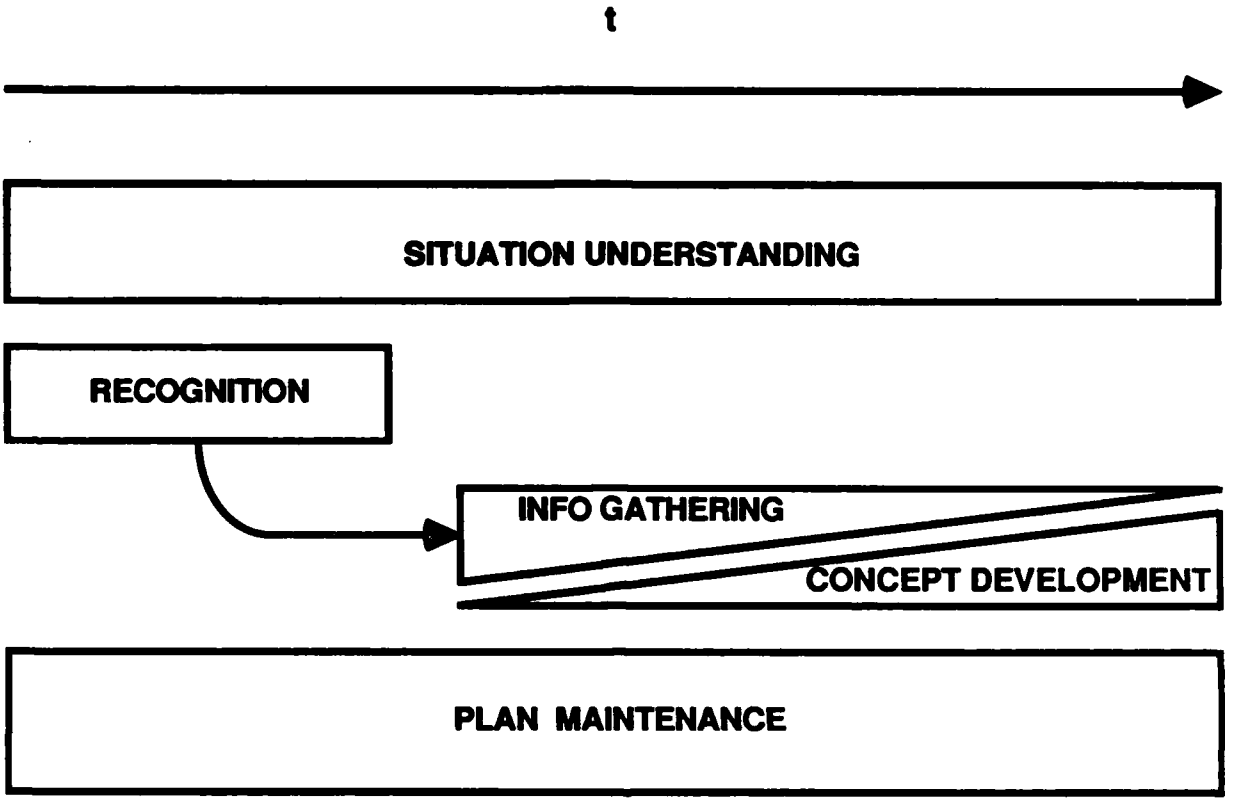




these alternative courses-of-action as the situation changes. The Continuous Planning process can be decomposed into several activities The following figure illustrates these activities.



3.1.1 Situation Understanding: This is a continuous effort not related to a specific plan or course-of-action. Continuous planning requires the capture and maintenance of information. This tracking of information is currently accomplished by the Intel and Operations cells, but it is conducted to support current operations, not planning for future operations. What information is required to support continuous planning is not well understood.

3.1.1.1 Operations/Plans Interface. Issues to address include:
- When do situation changes require planning actions?
- How do planners become aware of this?
- When do planners turn a plan over to operators?

3.1.1.2 Commander's Intent. Commander's Intent is the critical element of situational understanding.

- There are identifiable features of Commander's Intent which are necessary to know before other phases of the process (mission analysis, situation asessment and course-of-action generation) are addressed. This implies that the process of understanding the Commander's Intent must be completed before the other processes are conducted.

- Understanding of intent must flow from two echelons above corps. Apparently only a general concept understanding for the second echelon above is required.

- Commander's Intent is a necessary element of a course-of-action. This implies that, for a corps course-of-action, the Commander's Intent element will address the corps Commander's Intent and the echelon above corps Commander's Intent. Corps planners will still consider the Comander's Intent for the two echelons above corps in developing this statement.

- A Commander's Intent addresses, at least, strategic and operational goals for a particular time period, geopolitical considerations, and basic assets.

- Commander's Intent provides a framework for resource allocation.

- Commander's Intent should include identification of enemy center of gravity. At higher echelons, center of gravity may refer to concepts like tempo of operations, destruction of forces, and threats. Commander's Intent is biggest constraint on types of COA's to be developed. It will influence what alternatives are to be developed.

3.1.1.3 Information Classification. The information which all planners need can be grouped into eight operating systems, namely, command and control, maneuver, fire support, logistics, air-defense, etc. For each functional area within the plans cell, the level of detail of the information on the planning map should correspond to what appeared in the, say, Logstat and SITREP for the 24-hour period. This should provide the essential elements of information at the level required for each planner to do his planning or else he would not have asked for those items in the first place. Every factor such as air defense, fire support, mobility/counter-mobility, command and control, NBC, etc. have to be addressed relative to METT-T. For example, if you are going to talk about Mission, you have to ask who's mission. The functional areas have different missions, the services have different missions, etc.

3.1.2 Course-of-Action Generation: Course-of-Action Generation can be decomposed into three general activities: Recognition, Information Gathering and Concept Development (these terms are not meant to mirror doctrinal terminology). All these activities collectively develop a course-of-action, or alternate courses-of-action, for a specific contingency. These activities are repeated for each contingency.

3.1.2.1 Recognition. Recognition is the stimulus which initiates action on one (or a set of alternative) COA (s). It is the recognition that planning action is required to satisfy a potential operational requirement, or contingency, at some time in the future.

3.1.2.1.1 Source. A number of potential sources for recognition were identified. These include:

- Commander's Intent will lead to a distinct contingency(ies).
- Commander's concern will lead to a distinct contingency(ies).
- Distinct contingerncies can be combined into another distinct contingency.
  -- Does not eliminate distinct contingencies which have been combined. They still need to be the subject of distinct planning efforts.
- Receipt of warning order from higher headquarters.
- Recognition that some new possibility exists. This may be generated from a number of sources in the command post (e.g., plans, ops, commander).
- Clarification of previously fuzzy future situation.
  -- This often occurs when the higher command is conducting a multi-phased operation. In this case, the corps will often plan multiple phases per single higher command phase, with connector phases between higher command phases.
  -- It often becomes impossible to plan later phases of the operation in sufficient detail due to the presence of two many variables.
  -- As the operation is conducted it will become possible to define the future situation sufficiently to plan for later phases.
  -- This is one of the basic mechanisms of continuous planning.

3.1.2.1.2 Content. There are potentially a number of data items associated with recognition which aid in bounding the operation. The data items are derived or selected from the information obtained by Situation Understanding.

3.1.2.1.2.1 Commander's Intent, at corps and the two echelons above corps. This can be a continuation or it can be a modification associated with the recognition.

3.1.2.1.2.2 Commander's Concept, at varying levels of specificity.
- Serves as initial strawman for later activities of process.
- May be multiple concepts.
- If not given by stimulus, then something needs to be generated before later activities are entered. Does not have to be specific - handwave often suffices.

3.1.2.1.2.3 Contingency priority.
- Commander directs is first priority.
-- May be contingency that is most likely.
-- May be contingency that most concerns him.
- Worst case or Most likely is next priority.
-- Likelihood determination based on terrain and enemy force support for contingency.
-- Factors for choice.
--- Time available.
---- Decision Support Template is a useful tool in determining time available for contingencies. Particularly timelines and decision points associated with DST.
- Contingencies can be planned simultaneously.
-- This is desirable.
-- Incremental, iterative development.
-- Do them together.

3.1.2.1.2.4 Enemy Force Knowledge.
- Red Army Boundaries.
-- Blue Defense operation.
--- Boundaries can relate to blue force integrity of defense.
---- Boundaries that cross blue boundaries threaten integrity of defense.
-- Blue Counterattack operation.
--- Influence determination of worst-case contingency.
- Red Force Disposition.
-- Blue Counterattack operation.
--- Must assume where enemy will be at start of counterattack.
--- Initial considerations at army level.
- Red Force Operation.
-- Blue Counterattack operation.
--- Army level of consideration.
--- Attack type of operation.
--- Relationship to Blue boundaries a concern.

3.1.2.1.2.5 Friendly Force Knowledge.
- Major combat equipment types.
-- Tanks (M1 vs M60).
--- Principally a logistics consideration.
---- DISCOM
---- Corps GS maintenance.
--- Can expect cross-country movement difference for battalions in the vicinity of 5 kph.
--- Combat speed for battalions essentially equivalent.
--- Can expect less combat attrition for battalion.
- Forces Available.

-- Counterattack.
--- Uncomitted from defensive concept of operation.
--- Assume those conducting defense in concept are committed and not available for major task.
--- Planning emphasis on assumed uncomitted forces.
--- For combined Reactive/Planned Counterattack must subdivide available forces.
---- What it takes to reestablish integrity of defense (Reactive Counterattack).
---- Remainder for planned counterattack.
--- Planned Counterattack. Counterattack force in defensive scheme with Planned Counterattack are considered committed forces.
- Force Disposition.
-- Counterattack.
--- Must assume where we will be at start of counterattack.

3.1.2.1.2.6 Terrain Knowledge.
- Planned Counterattack.
-- Identification of areas not to attack.
-- Identification of areas that support maneuver, or Avenues of Approach.
--- Identification of amount of forces that can be accomodated on each.

3.1.2.1.2.7 Mission Knowledge.
- Counterattack.
-- Initial Planned Counterattack handwave comes from concept for defense.
-- Planned Counterattack is a continuation of initial defensive operation.
-- Handwave identifies how to get to objectives.
-- Two concerns of mission analysis for corps.
--- Mission Analysis of army group commander order and concept.
--- Mission Analysis of corps commander's planning guidance to develop subsequent mission statement for corps and subsequent concepts.
-- Corps Boundaries
--- Place constraint on allowable movement of forces

3.1.2.1.3 Mission Analysis. The doctrinal activities of Mission Analysis are included within Recognition. At the completion of the mission analysis the planners have developed the following information items to be used by the remainder of the planning process:
- Tasks to be accomplished by the corps during the ensuing operation.
- Constraints under which the corps is to operate.
- An "understanding" of the intent of the higher commander in the ensuing operation. From this understanding of the commander's intent, it may (should?) be possible to develop a number of evaluation criteria for use in the following phases of the planning process. The remainder of this paragraph (3.1.2.1.3) enumerates these possible outputs of the mission analysis phase (potential evaluation criteria) of the planning process which would have an influence on subsequent phases of the process.
-- Time Constraints. Severe time constraints support development of plans which are simple to implement at lower levels (i.e., subordinate commands have a simpler planning problem) and simple to execute.
-- Implied Tasks. This includes both short-term objectives and long-term objectives.
-- Identification of Subsequent Operations.
--- Must finish operation in posture to do what is needed next. This will impact how you approach accomplishing objective.

--- Must finish operation in posture to support commander's subsequent operation.

--- For example, if the corps mission is to conduct a limited counterattack to secure an objective, the commander's intent in directing the counterattack may be either of 1) seize and retain terrain objective, or 2) capture terrain to facilitate deep counterattack with Axis through objective. These options dictate different allowable postures upon completion of the counterattack and different subsequent operations for the corps.

–Be Prepared Constraints.

--- Missions. These can influence the type of operations you can conduct.

--- Lose a designated element (name or type) of your force.

--- These will impact corps' use of the force, in that they have a certain level of commitment they cannot breach.

--- Corps must be prepared to adapt to the loss of the force.

-- Availability of Fire Support Assets from outside Corps.

--- EAC operations (e.g., deep interdiction) may imply the EAC assets will not be available for corps.

--Preservation of Force vs. Accomplishment of Objective. When preservation of the force is given priority, the following is true.

--- More likely to impact how tasks will be accomplished than what tasks will be accomplished. Less likely to conduct high-risk operations.

--- Normally more important to operations than planning.

--- Counterattack less likely.

--- If conducted, depth of counterattack would be less.

-- Constraints on Reserve Force.

--- Size of reserve.

--- Position of reserve.

--- String on commitment of reserve. This could particularly effect maneuver, fire support and aviation elements.

---- Commit only with higher command approval.

---- Constraint on time to react to contingency.

--Constraints on Covering Force.

--- Size of covering force.

---- Attrit enemy well forward implies strong covering force.

---- Develop something early implies strong covering force.

---- Forward divisions need time to deploy implies strong covering force.

--- Time of covering force action.

---- Forward divisions need time to deploy implies the duration of the covering force action will extend at least until divisions can deploy.

--- Covering force activity .

---- Covering force needed for further operations implies no decisive engagement.

---- Don't let covering force fall below certain strength implies limitation of covering force activity.

3.1.2.2 Information Gathering. Information gathering is the activity of determining the information required for COA development, acquiring this information if available, and producing this information if not available. In general terms, the intent of the information gathering activity is to determine the characteristics of the situation that can influence the corps' capabilities to perform its mission regardles of which particular course-of-action it develops. The Plans Cell will attempt to forecast relevant elements of the battlefield situation between now and some point in the future, when the corps expects to conduct some operartion as part of the performance of the corps' mission. Information gathering is characterized by interplay between functional areas within the plans cell, and interplay between the plans cell, other cells within the command post, and the functionally specialized units.

3.1.2.2.1 Information Requirements.

3.1.2.2.1.1 Baseline Situation Descriptions. Functional area reps within plans cell will obtain detailed baseline situation description for their functional areas. This baseline situation description is tailored based on the information produced by the recognition activity, and information developed by other functional areas. Baseline descriptions will be obtained for own forces, subordinate forces, and higher command forces (if available for use/tasking) within functional area. Baseline descriptions will include as much projection of the future, based on continuance of the current operation, as is available.

- Friendly Forces Baseline Description.

-- Range of echelons. Doctrinally, the corps fights with divisions, brigades and battalions but in practice planners probably only plan and fight with Brigades.

--- Battalions are the smallest level unit that corp planners can move around.

--- Regarding Battalions, planners are concerned primarily with maneuver Battalions.

--- There is such a large number of Battalions in a corps that planners probably do not think in terms of Battalions.

--- The problem with planning in terms of Battalions is getting information on them and keeping it current. Their status may not be accurately reflected in reports received by corps.

--- Combat and Combat Service Support (CSS) elements are managed at Brigade level. From a G3 Planner's perspective, information on Battalions is used to think about combat power ratios. However, its not certain that one can fight over extended periods thinking in terms of Battalions because fighting is the culmination of a lot of work above Battalion level.

--- Planners need to know which Battalions are his, what each unit's combat readiness value (color code) is, and its type (mechanized or armor), and general location.

--- Planners need to know differences between his Brigades (e.g., mechanized- vs. tank-heavy).

--- Organization (peacetime vs. combat) might be different and planners must be made aware of this.

-- Combat Status. Division, Brigade and Battalion units need to be color-coded for each of the four standard readiness items (equipment, personnel, fuel and ammunition) in terms of their percentage of combat readiness. The color coding indicates combat readiness of each unit whether it is in action or in reserve. For example, the color yellow may indicate the category is at less than 60%, whereas the color green may indicate that the category is at least at 60%. Some formula exists for combining the values of the four categories to produce a single category called combat effectiveness which can have one of two possible values (combat effective and combat ineffective). If a unit is combat ineffective then it cannot be used. The combat effectiveness status of the unit drives the estimate of what the planners will need in order to make the unit combat effective.

-- Logistics

--- The only important piece of information which planners need to know about Brigades' transportation capabilities is that the Brigade commander can dictate the use of Supply and Transportation (S & T) platoons inside of Battalions. Therefore, the Brigade commander can marshall truck assets if necessary.

--- Information on truck assets is necessary.

--- One COSCOM responsibility is to supply Divisional and non-Divisional support. For example, in Divisional support, if his Brigade or DISCOM assets go down, the COSCOM would need to know that information. They would need also to know how well the Division could service itself. If status was lower than TO&E then the COSCOM would have to provide the Division with the necessary assets to move with respect to the its local situation. Divisions have limited capabilities logistically (even heavy Divisions) and almost always require logistic support from COSCOM.

--- Brigades are not just the sum of their combat assets but include their logistics assets also.

--- At each echelon there is a wartime 2715 (unit-readiness report) which, in peacetime, includes logistics, personnel and training (not included in wartime). The data in this report is aggregated

at Bn level and flows up to corps. Corps gives this information to the COSCOM in order to react, in terms of maintenance, to degradation of combat units. Thus, the corps planner has visibility, logistically, from a very low level all the way through each echelon up to and including theatre.

-- Ammunition.

--- As a planner, the only information on ammo availability required is to know whether there is enough. The problem of determining whether there is the right mixture of ammo is a problem for Division level.

--- Types and quantities of rounds available, and how it can be moved to desired locations. This information is provided by the COSCOM and the G4.

--- Types and quantities of smart weapons, and how it can be moved to desired locations. Planners also need to know if weaponry and designators effective against the enemy are available. This information impacts forecasting by planners.

-- IEW.

--- Current status of equipment and any expected problems. This information is provided in terms of equipment type such as jammers, collectors, etc.

--- Task organization of IEW elements as specified by Division.

--- In direct support of Brigade or general support of Division.

--- Current status and activities of units.

-- Fire Support.

--- Kinds of air available to corps.

--- Types of airframes available to corps.

--- Weapons mix.

--- Available munitions.

---- Available high-tech munitions (e.g., Copperhead or laser-guided bombs).

--- Resupply rates.

--- Changes in ammunition usage (Planners need to influence requests and allocations of ammunition. After a change in usage is detected, it takes at least 24 hours for a change in resupply flow to manifest itself in an artillery Bn.).

--- Unit status (similar to description given above for maneuver units).

--- Available number of minutes and meters of illumination on the ground for a particular geographic area.

--- Available quantity of smoke for a particular geographic area.

--- Changes in command relationships (GS vs. GSR) of artillery at Division level.

--- Status of acquisition systems (status of intelligence systems collecting determines munitions that can be used both from ground and air standpoints).

--- Designation systems. The essential information here is to know whether the critical designator systems are available or not. It would be nice to know the following:

---- Weapons requiring them.

---- Types available.

---- Status.

---- Locations.

---- Limitations.

- IEW baseline description.

-- Intelligence Estimate. Estimates of capabilities and intentions should be in the intelligence estimate and other IEW periodic reports.

-- Templates/IPB. Numerous terrain templates/overlays assist in providing the baseline descriptions. Three enemy force template types are used at corps level in the IPB process. At least one, the Decision Support Template, is of use in planning.

- Log baseline description.

-- Log status.
-- Log capabilities.
- Personnel baseline description.
- Information concerning status of adjoining forces is required.
- Information concerning status of joint (air, navy, etc.) forces is required.
- Information concerning status of higher command forces is required.

3.1.2.2.2 Information Development.

- Want to define what operation will do between now and point in future planners are trying to forecast.

- Want to define what forces (red and blue) will look like at point in future planners are trying to forecast. Red side must be as equally thought out as blue side.

- Want to define capabilities of forces at future points in time.

3.1.2.2.3 Functional Area Interplay.

- The interplay between the functional area specialists within the plans cell assists in development of the baseline functional area description.

- The interplay between the functional area specialists within the plans cell will also serve to more precisely define the general concept(s) initially developed by the Recognition activity.

-- This aids functional area specialists in developing the information required for the COA Development activity.

-- Ideally, functional area specialists need combat scheme of maneuver and timelines for execution. In other words, phases of operation and timelines for phases.

3.1.2.2.4 Specific Functional Area Information Requirements.

3.1.2.2.4.1 Required by the G2 Planner.

- Battlefield Area
  -- Area of operations.
  -- Area of influence.
  -- Area of interest.
- Terrain
  -- Vegetation.
  -- Surface material.
  -- Surface drainage.
  -- Surface configuration.
  -- Obstacles.
  -- Lines of communication.
  -- Observation.
  -- Fields of fire.
  -- Concealment.
  -- Cover.
  -- Key terrain.
  -- Avenues of approach.
  -- Mobility corridors.
  -- Cross-country movement (wet and dry).
  -- Slope (go and no-go).
  -- Built-up areas.
  -- Air avenues of approach.
  -- Drop zones.
  -- Landing zones.

-- Hydrology.
- Weather
-- Light data
--- BMNT, BMCT, EECT, EENT, moonrise, moonset, percent of illumination, etc.
-- Climate (historical summary).
-- Precipitation.
-- Ceilings and visibility.
-- Fog.
-- Temperature.
-- Winds (surface and aloft).
-- Humidity.
-- Weather forecast.
- Threat Forces.
-- Range of echelons from army level.
--- Two echelons up.
--- Two echelons down.
-- Specialized Functional Entities.
--- RAG's.
--- DAG's.
--- Operational Maneuver Groups, At enemy force Front level.
---- Exploitation force to achieve a specific objective like seizing crossing sites on rivers or seizing a key installation (G2 Planner wants to know OMG's objectives - provided in intell estimate).
---- Probably corps size.
---- Committed when advantageous.
---- Probably a tank-heavy force (probably 2 tank divisions and 1 mech. division).
---- Looks at targets probably 100-200 km behind the FLOT.
---- Less important than Front's first and second echelon to the G2 Planner.
-- Commanding Officer.
-- Status.
--- 1st echelon, or 2d echelon, or Follow-on.
--- Committed or uncommitted, time-to-commitment.
-- Organization.
-- Tactics.
-- History.
--- Jamming.
-- Doctrine.
-- Composition.
--- Capability Differences of Soviet Mechanized vs. Armor Divisions. Major difference is equipment.
---- Mechanized division is balanced in that the number of tanks approximately equal number of APCs.
---- Armor divisions are not balanced because they are armor heavy.
---- Tanks are limited in maneuverability and target engagement compared to mech vehicles.
---- Tanks move faster.
---- Tanks are more survivable unless defender has good anti-tank capability.
-- Disposition.

-- Strength.
--- Committed forces.
--- Reinforcements.
--- Air.
--- CBR.
--- Relative strength.
--- Logistics.
-- Training.
-- Relative mobility.
-- Templating.
--- Doctrinal.
--- Situation.
--- Event.
--- Decision. One of the information products produced by the intelligence cell and used by planners is the Decision Support Template (DST). Documentation on the IPB process states that the friendly forces influence on the enemy force will be included in the development of the DST. It appears, therefore, that wargaming is used in development of the DST. The AWC participants agreed that the DST is very much the result of an "if-then" type of process. The intelligence cell produces two types of DST: one for current operations and one for planned operations (a particular friendly force course-of-action).

-- Politics.
-- Economy.
-- Personalities
-- Recent and present significant activities.

- Enemy Capabilities.
-- Attack.
-- Defend.
-- Reinforce.
-- Delay.
-- Withdraw.
-- CBR.
-- Air.
-- indications of enemy intentions.

- Enemy Vulnerabilities. A vulnerability is something to exploit which gives the friendly force an advantage (usually vulnerabilities are associated with equipment). Some types of vulnerabilities include:

-- Not equipped to handle NBC
-- Combat ratio in friendly favor because of enemy disposition
-- Lack of bridging equipment
-- Lack of close-air support
-- Maneuverability limitations
-- Rigidity in command and control (doctrinal)
-- Personnel (less than 80%).
-- Morale/health.
-- Logistics.
-- Tactics.
-- Personalities.
-- Equipment (less than 80%).
-- Mobility .

- Enemy Course-of-Action
-- Most likely.
-- Objectives.
-- Who, what, when, where, in what strength.

-- Advantages/disadvantages.

-- Center of gravity. This is what the enemy will concentrate on. For example, if Red forces believe its necessary to seize and/or control a particular terrain feature in order to make the critical penetration of Blue forces (which will split the corps), then this particular terrain feature is the Center of Gravity of the Red forces. If Blue forces prevent him from seizing or controlling that terrain feature, then the Red force will lose.

-- The following table shows the factors addressed in a CoA for an enemy force Front based on echelon levels of the enemy force. The intell estimate is on the Front. Time estimates refer to times when the enemy will reach objectives and times when the enemy will begin an action.

Echelon	Final Obj	Daily Interm	Daily Ultim	AA	Ident	Spatial Relations	Air & Arty Support	Tactical Types	Time Estim.
FRONT	X	X	X		X	X		X	X
ARMY		X	X		X	X	X	X	X
.									
.									
DIV		X	X	X	X	X	X	X	X
.									
.									
REGT					X	X			

- Friendly Course-of-Action

-- Where to maneuver, shoot, jam and communicate.

-- When to maneuver, shoot, jam and communicate.

-- What to maneuver, shoot, jam and communicate with.

-- What to maneuver, shoot and jam.

-- What results to expect.

3.1.2.2.4.2 Required by the G4 Planner. It is extremely important to the G4 to kept in the decision cycle of the U.S. commander. Also, a major function of the G4 in the plans cell is to give broad, long-range guidance for planning to the COSCOM, but to not do the work itself. The G4 needs to remember all friction points that can occur that are unknown such as morale and fatigue of the troops, etc. It should be noted also that levels at division and below do not have asset visibility over all things the G4 has at corps. And at theatre level they have alot more assets available that could be useful to the corps. These assets may provide a solution if corps was given main priority of effort (on some operation). The point is that the corps G4 Planner might be able to provide a solution using theatre assets that were not available and known to COSCOM. Information of the types listed are used by the G4 Planner in his identification of the logistical shortfalls and solutions to such shortfalls. Coordination would be hard-copy, telephone, radio, or a visit to various echelons like COSCOM, DISCOM, Theatre Army Area Command (TAACOM), and Transportation Command.

- Terrain. Overlay provided by COSCOM. G4 in plans cell would either retrieve overlay himself or have it FAXed or use some other method to get it. Many other bits of detailed information would be required by the G4 in the plans cell. Note: COSCOM obtains the overlay from the intelligence cell.

-- Main supply routes.

-- Rail-lines.

-- Airfields.

-- Waterways.

--- Rivers, canals, lakes, bays, oceans.

-- Bridges.

-- Obstacles.

-- Overpasses.
-- Urban areas.
-- Ports.
-- Weather conditions.
--- Mud, snow, ice, fog.
-- Percent slope of roads.
-- Off-road capability.

- Troops Available.

-- Location of combat forces and combat service support (CSS) forces of all armed services.

-- Functional status of CSS services.
-- Number of days of supply for all classes of supply.
-- CSS available from host nation and allies. The G4 Planner uses this information to determine how the CSS from host nation and allies could alleviate the corps' logistical shortfalls. CSS from host nation and allies is one of the major ways of alleviating such shortfalls.

- Pipeline to the rear of friendly forces. The G4 Planner uses this information to determine what CSS would be coming to friendly forces. This assessment of the pipeline would project back to the seaports and would be a principle concern of the logistician with respect to developing future plans. The pipeline represents another major way to alleviate logistical shortfalls.

- Time.

-- Quantity available. The G4 Planner needs to know the time constraints on identifying all of the various bits of information that are necessary to reach a logical decision regarding logistics.

3.1.2.2.4.2 Required by the Communications Planner. The following information items are critical in determining communications measures.

- Information from other functional area specialists in plans cell.
-- Intelligence Preparation of the Battlefield (IEW).
-- Terrain for operation (IEW).
-- Special communications requirements.
--- Technical requirements, such as interfacing to allies.
--- Communications to/from a specific location or towards a specific direction.
--- Necessity to maintain communications to a particular person or between persons.
--- Special requirements for a particular unit (OPS).
-- Phases of operation (OPS).
-- Specific information requirements (OPS, IEW).
-- Support prioritization (OPS).
-- What information needed at what point of operation (OPS).
-- Control Measures in effect (OPS).
-- How corps is going to echelon (OPS). Will determine how to break down corps signal brigade.
-- Translated Commander's Intent (OPS). Looking for constraints on what can be done with signal assets.
-- What kinds of combat losses are expected (OPS). To support redundancy planning and loss preparation.
-- How will corps displace elements and where are critical points during displacement.

- Information from without plans cell.
-- Status of all equipment that can be called on. Equipment of higher/lower/ subordinate.
-- Support ability of higher headquarters.

-- Host nation support ability.
-- Capabilities estimates.
- Information to functional area specialists in plans cell.
-- Estimate of communications support capabilities given certain operation (OPS).
-- Estimate of communications risk in providing specific types of support for specific operations. Risk is tied to ability to support operations in the future (OPS).
-- Communications key terrain (OPS). This key terrain estimate is based on three considerations: 1) where to position major C2 elements; 2) where high density communications entities (e.g., LOC's, corps artillery) will be located; and 3) terrain to support communications in most uninterrupted manner for displacing elements.
- Planned counterattack.
-- Size of force in counterattack.
-- Actions/timetable for other corps elements when counterattack occurs.
-- C^2 arrangenents for counterattack force.
-- Support arrangements for counterattack force.

3.1.2.2.5 A Model of the Situation Assessment Process: The G2 Perspective. Figure 1 shows a model of the different functions, and their relationships to each other, as performed by the G1, G2, G3 and G4 Planners. The arrows indicate logical dependencies between the functions. The notation on the arrows indicates the staff area performing the function. The AWC participant who produced this model noted that if he were the G2 Planner he would want to know just the output of the "Estimate Enemy Course-of-Action" function and the basis for the estimate. Figure 1 was described as follows:

1. Start with the information needed to evaluate the battlefield area.
2. Simultaneously analyze the terrain, weather, and enemy threat.
3. Simultaneously identify capabilities and vulnerabilities of the enemy force.
4. Develop an enemy force course-of-action.
5. Combine input from G1, G2, G3 and G4 to develop a course-of-action for the friendly force.
6. Do situation development and target development.

Note: Time required for plan implementation should also be taken into consideration.

3.1.2.3 Concept Development. Continuous planning is proactive (vs reactive) and long-term.For purposes of this document the Course-of-Action Generation process commences upon receipt of a new mission (to include commander's guidance and intent) from any source, and terminates upon completion of the alternative courses of action (or single course of action). There is no clear break between the activities of information gathering and COA Development. Perhaps it is best understood as two activities that progress simultaneously, initially with an emphasis on Information Gathering, but gradual change to emphasis on COA Development. It is understood that this is in contradiction with the process as described by doctrine (FM 101-5) in that the separate staff analyses are not required. However, the planners agreed that in the European context, the staff analysis at corps consisted of attempting to identify "aberrations" in the situation, and, in the absence of these aberrations (radical changes in the situation, caused by the loss of continuity of the operation), the planners will deal with staff information in its routine form. One aberration is significant enough to merit special attention, however, and that is when the corps is forced to change its environment (terrain and opposing force) as a result of the new operation. In that case, the planners must wait for the production of the detailed staff information. A second significant aberration occurs when there is a change in the operation type to be conducted (e.g., attack is changed to defend). Normally the higher command's mission statement for the corps will contain sufficient information to determine whether or not a detailed staff analysis is required. Course of action generation can be subdivided into five phases which are commonly, but not always, performed in a predictable sequence.

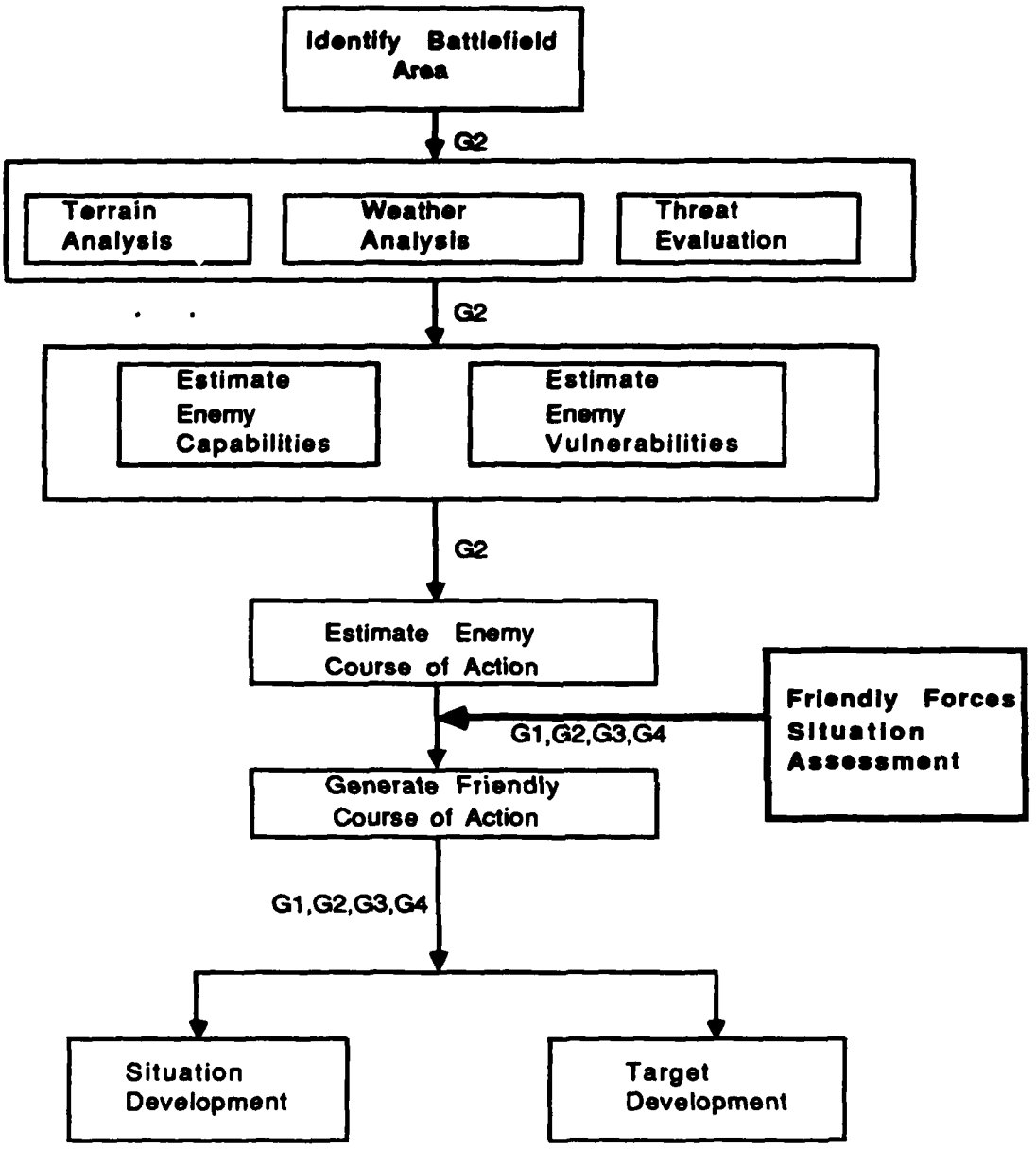


FIGURE 1

3.1.2.3.1 Scheme of Maneuver (SM) Development. The SM is developed first. All factors of METT-T must be considered in developing the SM. At a minimum, the commander's understanding of the METT-T factors must be verified. From the above it is clear that this does not require a separate staff analysis effort unless an aberration is noted. The Scheme of Maneuver is discussed in more detail in paragraph 4 below.

3.1.2.3.2 Task Organization (TO) and Task Allocation (TA). After development of the SM, a TO can be developed and tasks allocated. These phases must be pursued in parallel and decisions made in either will effect decisions to be made in the other.

3.1.2.3.3 Command and Control (C^2) Measures. After developing the SM and TO and performing the TA, it is possible to specify the C^2. The C^2 consists of a number of elements, which include:

- Synchronization of Operations (this is the key element). Synchronization of force activities is critical to fighting the battle but it does not happen very often. Synchronization is the responsibility of the commander and the individual running the TOC (G3; Chief of Staff, whoever). The functions performed in the TOC cannot be done independently of one another.
- Communications measures, to include the allocation of corps' signal assets
- Command post(s) location(s).
- Reporting mechanisms.
- How to control the battle.
- Control Measures. At one point in the discussion, it was agreed that precise unit boundaries were not important in developing courses of action. A general definition is sufficient, and the precise boundaries are best decided by the neighboring units.

3.1.2.3.4 Support Priorities (SP). As an alternative to TO changes, support priorities can provide a combat multiplier impact.

3.1.2.4 COA Generation Process.

3.1.2.4.1 General Description. Given general intent (or general guidance about what to pursue) of the commander or G3, the operators in the plans cell will develop a relatively small number (probably 3 or 4) of skeletal schemes of maneuver. The operators will present these skeletal schemes of maneuver to the functional area specialists within the plans cell (i.e., the Personnel, Logistics and Intelligence individuals and the non-operators of the G3 area) and ask for an assessment of these schemes from the perspective of each functional area. The assessment may involve getting information from the technical entities (COSCOM, DIVARTY, Intelligence Cell, etc.). Each functional area representative in the plans cell will report back to the operators regarding the schemes of maneuver in terms of such things as how well each scheme of maneuver can be supported (the functional area representatives may need more information from the operators before they can give their assessments). Having received these assessments, the operators will evaluate each skeletal scheme of maneuver and either: (a) discard it from further consideration at this point in time, (b) keep it but not develop it further at this point in time, (c) modify it so that it is another skeletal scheme of maneuver (which they may present to the functional area representatives at the current time or at some time in the future, or (d) keep it and begin developing it into a complete course of action. This is an iterative process.

3.2 THE PLANNING FUNCTION. The following statements characterize the planning function as practiced at the corps level in the European environment in an active context.

3.2.1 Corps Plans Cell. An Army of Excellence TO&E for the corps G3 planning section has yet to be adopted. However, based on the division G3 planning section TO&E, which has 13 majors representing the combat, combat support and combat service support functional areas, it is presumed that the section will contain officers of the combat, combat support and combat service support functional areas. The purpose of this section is to develop the operations plans. The functional area representatives are actively engaged in the planning activity, contributing advice and analysis on the aspects of the plan effecting their area of expertise (e.g., the intelligence officer is concerned with the intelligence aspects of the operations plan, the logistics officer with the logistics aspects of the operations plan). They do not provide situation information (the staff does this), nor do they develop the functional (e.g., intelligence collection or logistics) plans and annexes (staffs maintain their own plans sections) which

implement the operations plan.

3.2.2 Plans Cell Planning Problems. The corps plans cell reacts to the commander, the Chief of Staff, or the G3. The commander tells the planners what he wants to achieve (i.e., his intent) and may tell the planners, to some degree, how he intends to achieve it (i.e., his concept of the operation). Planners have autonomy in developing detailed plans for fulfilling the commander's intent and his concept of the operation. Planners also have autonomy in the sense that if they have finished a plan and it has been approved (i.e., they have met all the current planning requirements of the G3), then planners may think of other plans on which to work. Planners must get approval of the G3 before they pursue development of these plan ideas. Planning problems can be initiated from a number of sources and can result in different types of planning activity. The following describes the sources of planning problems and the corresponding types of planning activities that may result.

- Higher Headquarters.

-- New Order. This results in a planning activity similar to what has been described in the planning process model.

-- Be Prepared Mission. This results in a similar planning activity. It is expected that these missions will be received more often as the situation becomes more fluid.

-- Warning. These are normally received from the higher plans staff and indicate possible future activities. It is important to note that the commander's intent is normally not available for problems of this type. In this case it is necessary to plan in general terms and develop several options which can be used when the specifics are received through one of the other two mechanisms.

- Corps Headquarters. Corps generated planning problems are concerned with the continuation of the operations required to accomplish the last received EAC mission. In this case it seems that the EAC commander's intent remains unchanged. However, the corps commander's intent may be modified.

-- Operations generated problem. The operations section is the recognizer. It is important for the plans officer to coordinate routinely with the operations section to determine future requirements, and what is most likely to be implemented. In this case it is also necessary to plan in general terms.

-- CDR/G3 generated problem. The plans officer should not be surprised if this occurs. Planning activity conducted to satisfy the first type of planning problem should be immediately applicable.

3.2.3 Other Corps Planning Problems.

- Operations section planning. The operations section can generate plans sufficient for short-term followons to current operations. In general, if the fragorder can be satisfied with an overlay, then the operations section can perform the planning.

-- Exception: The operations section is too stressed to perform the activity.

-- Exception: The personalities involved (particularly the commander) may effect this general rule.

-- In any exception, the Plans Cell would perform the required planning. Actual performance will depend on decision of G3.

-- A special case exists if need is recognized in Tac CP by CDR and/or G3. Since no Plans Cell exists in Tac CP, CDR/G3
with operations section assistance would perform planning activity.

3.2.4 Situation Projection Requirements. The necessity to "look into the future" is motivated by two operational requirements, the corps reserve and the deep battle.

- Committment of corps reserve.

-- When and where to commit reserve is most important decision corps will make.

-- Commitment of reserve takes time and cannot be stopped. Decision must be made in sufficient time to allow commitment at decisive place at correct time.

--- Time and space movement requirements. Reserves are large formations that take space on roads, and take time to prepare for movement. Additionally, reserves are normally placed away from contact to keep them from being attacked.

--- Planning time requirements.

--- Time required to prepare for operation upon commitment.

- Deep Battle. Special planning cell exists to plan for deep battle operations.

- Doctrinal expectation of 72 hour projection is best viewed as a goal. In the experience of the session participants, it is realistic to expect a decent projection for 24 hours.

- Context. Given the identification of friendly force capabilities and a concept for which planners will develop a number of friendly force courses-of-action, the all planners will try to estimate the battlefield situation for some point in time in the future (which needs to be determined based on an event that needs to occur, or a time given by higher headquarters, or possibly other things).

- Methods. Two wargaming methods the planners would use for this estimation problem were identified.

-- React/Counter-react Method. The planners would start with a general scenario. He would try to predict the enemy's reaction to a friendly forces operation in a particular location. Next, the G2 planner would predict the enemy force reaction to particular friendly force courses-of-action. The react/counter-react cycle can be played out to some future point in time.

-- Trend-extrapolation Method. The planners will use historical information based on the current engagement with the enemy to estimate the situation for the desired future point in time. Weeks, days or months of engagement with the enemy will probably allow identification of trends in enemy behavior. For example, if the enemy continues to attack for the next three days (most likely enemy course-of-action), then he is likely, based on his history with our forces, to gain 6 km/day and therefore be in location x-ray at a particular time.

- Estimating the Battlefield Situation

-- Planners will try to estimate (for some desired future point in time) strengths of the enemy force (G2 Planner) and friendly force.

-- Planners will try to identify areas where the friendly commander can influence what the enemy forces will do.

-- The G2 Planner has to make estimates of how the enemy would react if the friendly force did a particular thing.

-- One part of friendly force course-of-action generation is to wargame each course-of-action to see what will happen.

-- Target Times for the Estimates

--- The G4 Planner must look out , in some cases, to weeks and beyond.

--- The G2 Planner probably would not estimate what the enemy situation will be much beyond 96 hours into the future. At corps, intelligence assets for looking beyond 96 hours do not exist. It requires theatre and national level assets to collect this information so corps relies on higher headquarters to provide this information.

--- If the corps has a long enough engagement history with an enemy force, planners might make a guess at what the enemy will be doing a week from the present time.

---The corps may develop courses of action for 24 hours into the future. Planning operations that cause divisions to maneuver requires a minimum of 24 hours just to get the divisions doing something different than what they are presently doing.

--- If the commander has not told planners the particular time he wants a course of action executed, planners will ask the G3 for this information. The one-third two-thirds rule generally is used for allocating the proportion of time to be used for planning at corps.

- Wargaming

-- The intelligence estimate planners get from the intelligence cell is needed before wargaming is started. The planners will take the intelligence estimate and produce their own estimate of the battlefield situation for the desired point in time when they expect the new course of action to be executed. This particular estimation process is situation assessment; not wargaming.

-- "What if" drills will be done for red and blue force actions (or lack of ability to take certain actions) at particular points in a course of action.

-- Alternative courses-of-action of the friendly force will be wargamed to try to determine

which one is best for achieving the desired enemy reaction.

3.3 CORPS COMMAND POSTS RELATIONSHIPS.

3.3.1 Tactical CP.
- Facilitate current forward battle.
- Concerned with activities along the FLOT and forward of the FLOT to the extent they influence the FLOT.
- Synchronizes and integrates resource allocations to forward elements in order to influence forward battle.
- Operations cell but no plans cell.

3.3.2 Main CP.
- Integrates forward and rear battles.
- Conducts deep battle.
- Obtains resources for all battles.
- Plans Cell and main operations cell.

3.3.3 Rear CP.
- Conducts rear battle.
- Integrates rear battle into overall operation (maneuver with logistics).
- Liaison with higher headquarters.

4. SCHEME OF MANEUVER. An initial discussion of the SM development process, which was conducted to develop a general characterization, succeeded in producing tentative agreement about something along the lines of the following:

> **Developing a Scheme of Maneuver consists of selecting a number of possible SM parts from a larger collection of known parts; and then constructing (assembling) the Scheme from these selected parts.**

From this characterization it is apparent that three elements of the SM development process merit further analysis: the collection of known parts, the selection activity, and the construction (assembly) activity.

4.1 SCHEME OF MANEUVER PARTS. In refence to the characterization of the SM development phase given above, the following statements further characterize the term used. **PARTS** are ways of doing things, and contrast to the sections, or **CATEGORIES**, of the Scheme discussed in FM 100-5. In a complete SM, all of the categories of the SM are "assigned" an appropriate part or parts. Assigning a different part to a category provides a different way of doing what the category says needs to be done. Many parts come from individual experience and are not specified by doctrine. Parts are best described by graphics and/or pieces of text.

4.1.1 Doctrinal Category Listing. A partial (doctrinal) list of categories of the SM includes the following (this list was extracted from FM 100-5):
- An outline of force movements.
- Objectives.
- Areas to be retained.
- Zone, sector or area responsibility.

- Maneuver options which may develop during the operation.
- Defensive counterattack maneuver.
- Airspace control.

4.1.2 Alternative Category Listing. The AWC participants expressed the opinion that these categories adequately reflected doctrine as expressed in FM 100-5, but did not reflect the actual categories they used when developing an SM. When considering their thought processes as they performed this activity, they were able to identify six categories that were consciously addressed. Based on this recognition, the decision was made to redefine the SM categories into the following set. Parts, then, could be easily viewed as alternative manners of answering these questions.

- Who
- What
- When
- Where
- How
- Why

4.1.3 Part Enumeration. The following enumerates the parts identified by the AWC participants. The enumeration is organized by category to which the part may be assigned. It is important to note that the parts are not mutually exclusive, in that a given situation may result in several parts being used in the same category. However, within a category, there are parts that may not be used together. Where identified as such during the discussion they are also identified as alternatives below. Another important note is that many of the parts are not sensitive to the type of operation, and can be applied to their category independent of the operation type. Again, where identified as such during the discussion they will also be identifed below.

4.1.3.1 Who. The Who category identifies the major subordinate elements the corps will have available for the operation. The parts available for this category are different from the other categories in that they are part of the METT-T factors themselves. The Troop List details the complete set of parts the planner has available. The Task Organization under which the corps is currently operating provides the initial decision point for identifying the Who parts the planner will use. The planners task in addressing the Who category is to determine whether the parts listed in the current Task Organization is sufficient, and, if not, what modifications need be made. When the Who parts have been selected, the planners will have identified the unit or units that the rest of the Scheme will tell what to do.In performing this task the planners consider the following factors:

- Costs/penalties associated with potential modifications. A principal cost would be the time required to effect the change.
- Components (of elements in task organization).
- Past performance of Task Organization. The inclination is to keep a good thing going.
- Availability of forces (numbers).
- Types of forces.
- Relative strengths of forces.
- Current locations of forces.
- Relative proficiency of forces. This would include experience.
- Orientation and personality of the force commander.
- Spirit of the force.
- Maintenance status of the force.
- Mobility of the force.
- Logistics status of the force. This is most often less important than the other factors since the cost to change this are often less than the cost to modify the existing task organization.

4.1.3.2 What. The What parts describe the major (and some minor) operations the units are to perform. When the Scheme of Maneuver is complete there will be at least one What part selected for each Who part

selected. If the Conduct part is selected, then another What part may also be selected. If more than one What part is selected (neither of which is a Conduct), then the Scheme of Maneuver will direct their performance in sequence. The following What parts were identified:

- Attack.
- Defend.
- Delay.
- Move.
- Prepare. Prepare can be construed to Be Prepared, in that Prepare tells a unit that it will perform another What in the future, although the other What part is not identified. It refers to a sustaining type operation in which the unit makes ready for general operations. It is not a contingency. Contingencies are covered by the Be Prepared directive. It was decided not to further discuss the Be Prepared directive. A Prepare mission will involve a significant amount of physical activity.
- Conduct (other potential terminology is "Associated Operations"). A Conduct What identifies the minor operations associated with the overall Scheme. Specifically, Conduct will include activities that involve less than the total force of the controlling unit. It is a grouping of related, specialized activities in support of another What given that force. Conduct activities are also selected from a collection of parts, which includes:
  - -- Raids.
  - -- Patrolling, to include or exclude ambushes.
  - -- Reconnaissance.
  - -- River crossing, if corps mission is related to river.
  - -- Screening operations.
  - -- Deception operations, although this part could also be selected for the Why category.
  - -- Covering Force operations. These operations are identified as a Conduct part since the Covering force operation is not a discrete form of maneuver, and is conducted as part of something larger. Normally, however, for the unit conducting the covering force, a Conduct Covering Force operations part will be the only What part assigned.
  - -- Spoiling attacks.
  - -- Offensive operations. Included in this would be actions such as a Reconnaissance-in-Force.
  - -- Move. To contrast this with the What part Move, this movement would be as part of or in preparation for, another activity.
  - -- Airmobile operations.
  - -- Airborne operations.

4.1.3.3 When. The When parts provide alternative means for specifying the times that the selected What parts will be either started, completed, or conducted within (duration). When the Scheme of Maneuver is completed there will be a When part associated with every What part. Each subpart of a Conduct What part will also also have a When part associated with it. These latter When parts are normally duration parts.The following When parts were identified:

- ASAP.
- A specified time.
- Daylight.
- Dark.
- H-Hour, or a time to be identified, from which other times will be computed.
- End Evening Nautical Twilight (EENT).
- Begin Morning Nautical Twilight (BMNT).
- Activity dependent, or upon something else happening.
- On Order.
- No later than (NLT).
- No earlier than (NET).
- Upon receipt. This normally applies to a planning activity.

- From/To, where the from and to are other When parts.
- Between (same comment as From/To).

4.1.3.4 Where. The Where parts provide alternative means for specifying the locations that the selected What parts will be either started from, completed at, or conducted within. When the Scheme of Maneuver is complete there is a single Where part associated with each What part. The case may be that a single Where part may be associated with more than one What part. The following Where parts were identified:

- Terrain objective.
- Geographic designation.
- In Zone (offensive operation).
- In Sector (defensive operation).
- Along Axis.
- Direction of Attack.
- Cardinal Direction. A cardinal direction would include a distance, another location, and a direction. For example, " 100 kilometers east of the IGB" would constitute a cardinal direction. Note that the distance may be zero.
- Distance From/TO, where the from and to are other Where parts.
- Route.
- Enemy Force, where the enemy force designation could include disposition information. An example of this is the Where part "the flank of the first echelon division".
- Friendly Force. A Where part may be specified by a relation to a Where part of another friendly force. An example of this is the Follow relation.

4.1.3.5 How. The How parts provide alternative means for accomplishing the What parts. Most, if not all, How parts can be associated with a single What part. When the Scheme of Maneuver is completed each What part will have a set of How parts associated with it. There is no necessary restriction on the number and selection of these How parts other than those designated as alternatives are not associated with the same What part at the same time (When part).The following lists the How parts by their association to the corresponding What part:

1) Attack.
- Hasty.
- Deliberate. Alternative with Hasty.
- Supported.
- Unsupported. Alternative with Unsupported.
- Main.
- Supporting. Alternative with Main.
- Illuminated.
- Non-illuminated. Alternative with Illuminated.
- Mounted.
- Dismounted.
- Combination Mounted/Dismounted. Alternative with Mounted and Dismounted.
- Deep.
- Shallow. Alternative with Deep.
- Narrow.
- Broad. Alternative with Narrow. The corresponding Where part also reflects this. Zone, Axis, Direction, Route indicate narrowing of the attack.
- Frontal.
- Flank.
- Reconnaissance-in-Force. This could also be listed as a subpart of the Conduct What part
- Daylight.
- Night. Alternative with Daylight.
- Pure.

- Task Organized. Also termed Cross-Attached. Alternative with Pure.
- With Preparatory Fires.
- Without Preparatory Fires. Alternative with With Preparatory Fires.
- Mode factors. These are often not explicitly stated, and could also be reflected in Why and Where parts.
  - -- Speed. More emphasis on speed implies more likely to bypass places of resistance.
  - -- Tempo, or degree of violence.

2) Defense.

- Defend.
- Delay.
- Withdraw.
- Rear Area Protection. Separate kind of Action.
- Static (positional) Defense. The emphasis is on holding terrain.
- Active Defense. Emphasis is on destroying forces. Alternative with Static. The two can be combi ned by giving them to What parts that are associated with different Who parts.
- Counterattack. Offensive form of defensive operation.
- Spoiling Attack. Offensive form of defensive operation. This is conducted forward of FLOT. A preemptive attack in the form of ground maneuver, artillery or air, or any combination.
- Point Defense.
- Economy of Force.
- Hasty.
- Prepared.
- Main Battle Area. Alternative with Hasty and Prepared. They reflect differences in degree of preparation and length of time to stay.

3) Operation independent.

- Priority of Fires. This is time-phased, in that at different times this part may be associated with different Who parts, but at any time it prioritizes the Who parts.

4.1.3.6 Why. The Why parts detail the commander's intent. Although there is no requirement to place a Why category (this is almost always the case in the development of FRAGORDs) into the disseminated Scheme of Maneuver, the AWC participants felt that all good Schemes did possess a Why category. Even if the Why parts are not included, it is necessary to decide on them when developing the Scheme. When the Scheme of Maneuver is complete there will be one or more Why parts which relate to the overall Scheme and one or more Why parts associated with each What part. The following lists the Why parts:

- Destroy Enemy Forces.
- Seize Terrain.
- Retain Terrain.
- Secure Terrain.
- Seize Initiative.
- Retain Initiative.
- Deny (any of above).
- Break Contact.
- Establish Contact.
- Retain Contact.
- Maintain Contact.
- Facilitate Future Operations.
- Facilitate Other (simultaneous) Operations.
- Disrupt.
- Delay.
- Deceive.
- Canalize.

- Continue.
- Reinforce.
- Extract.
- Move or Maneuver.
- Protect.
- Consolidate.
- Reorganize.
- Reorient or Redirect.
- Relieve.
- Exploit.

4.2 PART SELECTION. It is possible to describe the part selection process at different levels. Several statements can be made concerning each of: The selection of parts within categories, a general process for selecting parts, relationship of the METT-T factors to part selection, and a general category sequence for part selection.

4.2.1 Category Knowledge. It is possible to describe the general part selection process by giving a general description of the knowledge which supports each category, as follows:

4.2.1.1 Why Parts: The appropriate Why parts for the corps are either given, or obvious. Their selection is driven by the mission and EAC commander's guidance. This is not necessarily true for the Why parts for the corps subordinates.

4.2.1.1.1 Restore integrity of defense.
- Does not require attack for What section of task description.
- Can also be accomplished by blocking position.
  -- Blocking position can be sized.
  -- Blocking position can be placed.

4.2.1.1.2 Deception.
- Want separate task for unit carrying out deception.
- Corps attempts to deceive either TVD or Front or both. Most likely TVD.
- TVD interested in division capabilities and movements.
  -- Must deceive TVD about division-level activities.
    --- Use of AA is not important.
    --- Division objective is important.
    --- Who division will fight is important.
  -- Must deceive TVD about division-level locations.
- Need to know what enemy looks for in identifying divisions to create deception.

4.2.1.2 What Parts: The appropriate What parts are driven, if not given, by the mission.

4.2.1.2.1 Defense.
- Corps Task must shape battlefield to facilitate subsequent operations.
  -- Will influence Where section of subordinate tasks.
  -- Accomplish geographic disposition of forces at some time out.
- Defense includes "win" mechanism.
  -- Element of defensive scheme that will win the battle.
  -- Options.
    --- Counterattack can be win mechanism (Planned Counterattack).
    --- Retain terrain can be win mechanism.
- All defenses need contingency for counterattack.

-- Planned Counterattack.
--- This is normally win mechanism if included.
--- Must contain enemy advance.
--- Forming a pocket with defense is one way to contain advance. Terrain considerations can support use of pocket. Friendly force heavy maneuver composition supports using a pocket. A pocket in this case is defined as a tactical situation in which the following holds: 1) the ability (terrain and force combination) to stop the advancing enemy force is present; and 2) the ability (terrain and force combination) to stop the enemy force method of attack is present. In the cited context, stopping method of attack means preventing following echelons from bypassing stopped first echelon.
-- Reactive Counterattack.
--- This normally restores win mechanism if executed.
--- Restores conditions that allow success.

4.2.1.2.2 Counterattack.
- Counterattack generally implies three tasks for subordinates.
-- Contain enemy advance.
--- Form pocket is one option to contain defense.
-- Hold flank of main attack.
-- Conduct main attack.
- Task 1 (contain defense) is normally task of defense Scheme of Maneuver.
- Task 2 (hold flank) and Task 3 (main attack) are additional tasks of counterattack Scheme of Maneuver.
- There are at least two potential purposes that can be associated with a counterattack.
-- Counterattack to restore the integrity of the defense. This will be termed a "reactive counterattack" for the remainder of the document.
-- Counterattack to secure objectives forward of the current main battle area. In this case the counterattack is an integral part of the defense. It is the win mechanism for the defensive scheme. This will be termed a "planned counterattack" for the remainder of the document.
- Planned Counterattack. Generally implies three tasks for subordinates. These tasks are added to the tasks for the original defense.
-- Hold flank of main attack.
-- Punch through enemy lines.
-- Conduct main attack.
-- Task 1 (hold flank), Task 2 (punch through), and Task 3 (main attack) are additional tasks of counterattack Scheme of Maneuver.
-- Tasks for defending units in counterattack.
--- Situational issue for each subordinate and should be decided separately.
--- Generally desirable to have them revert to attack.
---- Attack need not be conducted from defensive positions.
--- Criteria for determination.
---- Ammunition availability. Ammunition shortages support remaining in defense.
---- Occupation of strong defensive positions support remaining in defense.
---- Desire to desroy enemy forces in contact support remaining in defense.
---- Desire to minimize casualties support remaining in defense.
---- Estimates that enemy force has not reached culminating point in operation support remaining in defense.
---- Estimates of non-ability to conduct attack support remaining in defense. Contributors to this estimate may include estimated attrition, consumption and fatigue. These estimates are relative to enemy forces in contact. Necessary information for estimates include time duration of operation, distances to be moved during operation, and size of enemy forces opposing operation.

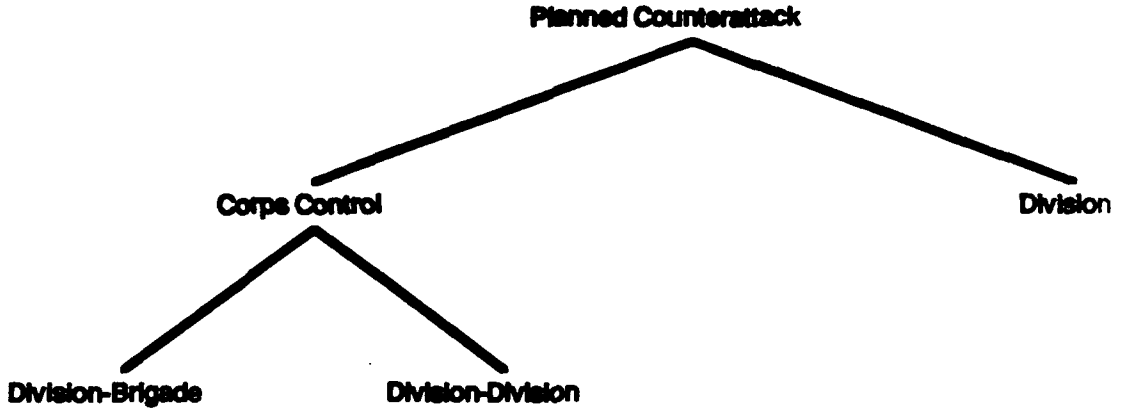
- Reactive Counterattack.
  -- Attempt to control unplanned salient created by enemy force action.
    --- Option 1. Push back salient.
    --- Option 2. Cut off salient.
    --- Option 3. Cut off and eliminate salient.
    --- Option 4. Stop salient growth.
    --- Will select option which is doable and best supports defense scheme win mechanism.
- Passage of lines.
  -- Executed by battalions.
  -- Controlled at brigade.
  -- Forces united at brigade level at passage time and point.
    --- Common commander.
    --- One brigade works for other to effect passage. Normally passing force comes under control of stationary force.

4.2.1.2.3 Deception
- Create a division-sized signal signature for smaller unit.
  -- Normally no spare equipment for performing this.
  -- Must accept signal risk elsewhere.

4.2.1.3 How Parts: The selection of appropriate How parts is heavily reliant on the situation as expressed in the METT-T factors. There are two summary measures of METT-T which are particularly useful in selecting the How parts: Relative Strength and Relative Mobility. See also What Parts for further discussion of How Parts knowledge.

4.2.1.4 Who Parts: The selection of Who parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Who parts.

4.2.1.4.1 Counterattack.
- Not realistic to expect subordinate that is main effort in defense to also conduct main effort in counterattack.
- Separate Brigade and Division Available.
  -- Planned Counterattack Task/Brigade sufficient for punch through enemy forces in contact.
    --- Three options available. Division option assigns division task for punch-through and for movement to objective. Division-Brigade option splits tasks. Division-Division option assigns punch-through task to division in contact at site of passage. Control of Separate Brigade in all options goes to punch-through task. The following diagram reflects the relationship between these options and criteria that follow.



--- Decision Criteria.

---- If initial objectives of breakthrough force are distinct and separate from the terrain the movement force will use then there is support for Corps Control options. Independently evaluated contributors to separateness are: 1) geographic distinctness; 2) distance; 3) necessity for breakthrough force to secure dominating terrain.

---- If breakthrough force and movement force are to fight different echelons of the enemy force then there is support for Corps Control options.

---- If there is no dominating terrain in breakthrough area and forces will be mixed during passage then there is support for Division option.

---- If size of two tasks is too much for one commander to control then there is support for Corps Control options.

---- If divisions and separate brigade cannot communicate then there is support for Division-Brigade option.

---- If corps cannot support another major subordinate command (MSC) then there is support for Division or Division-Division options.

---- If movement division cannot support another major subordinate command (MSC) then there is support for Corps Control options.

---- If defending division cannot support another major subordinate command (MSC) then there is support for Division or Division-Brigade options.

---- If there is a deception requirement then there is support for Corps Control options.

---- Expected physical locations of units at start of operation. Closeness provides support for division control in execution. Separation provides support for corps control in execution.

---- Commander capabilites. CG estimate of relevant commander's abilites to orchestrate required actions. Relevant commanders include division CG's and corps deputy CG.

---- Equipment types. Dissimilarities in equipment types supports the Corps Control options.

---- If two battles will occur simultaneously then there is support for Corps Control options.

---- Subsequent mission for either force supports Division-Brigade option.

---- Separate axes supports Division-Brigade option.

4.2.1.4.2 Deception.

- Implies weighting force with signal assets to provide deceptive electroninc signature.
- Separate force for deception task.

4.2.1.4.3 Armored Cavalry Regiment.
- Particularly suited for semi-autonomous operations.
  -- Terrain prohibits lateral movement into or through sector.
- Suited for high-level control and coordination, such as boundary coordination.
- Planned Counterattack.
  -- Long distance supports movement of ACR with win force.
  -- Weaker enemy force supports ACR with win force.

4.2.1.4.4 Separate Brigade.
- Can treat as standalone unit. Not necessary to put them under some kind of package.
- Can be assigned a task.

4.2.1.4.5 General.
- CG direction can include number of entities to consider.

4.2.1.5 Where Parts: The selection of Where parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting Where parts.

4.2.1.5.1 Defense.
- Extremely important in shaping battlefield.
- Likely to be specified geographic locations for subordinate tasks.

4.2.1.5.2 Counterattack.

4.2.1.5.2.1 Reactive Counterattack.
- Need to address where the mass of enemy forces are.
- Control salient.

4.2.1.5.2.2 Planned counterattack.
- How to get to objective is answer for Where section of planned counterattack.
- Avoid mass of enemy forces.
- Minimize water crossings.
- Positioning of available forces important.
  -- Can be changed during current operation to facilitate subsequent operation (this can be costly).
  -- Must balance against why they were positioned there in the defense to begin with. Concept of defense critical in this determination.
- Existing Corps boundaries constrain movement of forces.
- Boundary Changes.
  -- Can be requested, but change takes time and coordination.
  -- Very difficult in allied environment.
  -- Can assume boundaries will not be changed soon after start of operation.
- Terrain important.
  -- Movement speed.
  -- Ability to maneuver.
  -- Brigade cannot straddle major obstacle to movement.

4.2.1.5.3 Deception.
- Geo locations can constrain which force operates in which area.
- Deception force does not share Avenue of Approach with main effort.
- At least two AA's for operation with main and deception efforts.

4.2.1.6 When Parts: The selection of When parts is also influenced heavily by the METT-T factors. It is common to consider METT-T factors not previously considered when selecting When parts. Initial development will put little, if any specificity on time.

4.2.1.6.1 Phasing.

- If corps task is phased then tasks to subordinates should also be phased in conjunction with phasing in corps task.
- Gradually will specify times.
  -- Certain standard time blocks exist that are not variable (e.g., movement of large forces, road movement).
  -- Integrate pieces of known time into lines where you are not sure of timing.
  -- Attempt to reach decision points. Decision points have to be backed off to allow you to do whatever it is you have to do.
- During operation planners will readjust (future?) time lines to account for operation as it is being conducted. This is necessary to measure effect of things happening that were not foreseen.

4.2.1.6.2 Counterattack.

-- Speed is extremely important in counterattack.

4.2.2 General Process Characterization. A general characterization exists for those categories which are strongly dependent on the analysis of the METT-T factors. This characterization can be stated as follows:

> **In selecting those parts that will be assembled into a Scheme of Maneuver you must consider all you know about all the factors of METT-T. As you do this certain parts will be eliminated as being not applicable to the situation. This leaves a set of parts which are potentially useful for this problem. This set of parts is further analysed in the context of the METT-T factors to select those which are best for the situation.**

The following comments relate to this description of the selection process.

- Best. The term "best" needs to be further defined. It is clear that the concept of an "optimal" solution does not apply. Best in terms of suitable is more appropriate.
  -- If the corps was operating in a staff planning mode then there would be many best solutions, each defining an alternative course-of-action.
  -- Suitability is often in the eye of the beholder.
- Assembly. Whatever is selected must also be put together correctly. The term "correctly" also needs to be further defined. At a minimum there seems to be two levels of correctness:
  -- The assembly is correct at the first level if it does not violate operational principles. If an assembled Scheme of Maneuver does not meet this criteria then it is a bad Scheme.
  -- The assembly is correct at the second level if it is acceptable to the commander. This is strongly dependent on the personality of the commander. A good Scheme is correct at the first and second level.

4.2.3 METT-T Factor Relationship. Any planning situation is uniquely described by a discrete set of METT-T factors. The number of potential combinations of factors which may exist is, for all practical purposes, infinite. Each of these combinations produces a corresponding discrete set of METT-T factors. Further complicating this is the fact that planners often have incomplete knowledge of the actual set of factors relevant to their particular

problem, and the nature of this incompleteness is often unknown as well. Due to this incompleteness, a planning situation may be described by one of a number of discrete sets of METT-T factors, each of which captures different incompleteness.

4.2.3.1 Higher Level Situation Descriptors. Planners find it useful to capture higher level situation descriptors from the information in the discrete set of METT-T factors describing the planning situation. These higher level descriptors are then used in the part selection process.

- Relative Strength is one such situation descriptor. Relative strength is a comparison of enemy and friendly strengths and weaknesses, and their ability to employ those strengths and attack those weaknesses. All factors of METT-T contribute to the assessment of relative strength.

-- Relative strengths can be described by place and time. In this case the the METT-T factors would describe a number of different relative strength descriptions, each differing in place and time.

-- Strength computations involve all that is known about the following METT-T factors:

--- Enemy forces available.

--- Friendly forces available.

--- Terrain over which the forces are to deploy.

--- Terrain over which the forces are to move.

--- Time available in which to move.

-- The Mission factor may effect which other METT-T factors are actually considered in the determination of relative strength. This is particularly true in considering the enemy forces.

- Center of Gravity is another potential descriptor. Center of Gravity refers to the enemy force. It is the object that, if seized or destroyed (potentially other Why parts may fit here as well) by friendly forces, will cause the enemy the most damage and allow the corps to accomplish its mission.

-- Center of Gravity may be a piece of terrain.

-- Center of Gravity may be an enemy force.

-- Center of Gravity may be an installation.

- Relative mobility is another high level situation descriptor. Relative mobility was not further discussed.

- Key Terrain is another high level situation descriptor. Key Terrain is any terrain, the possession of which gives the owner a specific advantage.

-- At corps, the following terrain features often contribute to Key Terrain: natural terrain obstacles, road networks, air avenues of approach, bridges (given conditions: river cannot be forded, and, river cannot be bridged with tactical bridging, and, no other class 60 bridges exist across river).

-- Force composition is an important factor in determining key terrain.

-- Terrain characteristics to evaluate include: on- and off- road trafficability, visibility.

- Avenues of Approach (AA). The AA is another high level situation descriptor

-- At corps level divisional AA's are major AA's and regimental AA's are minor AA's.

-- If terrain is characterized by many minor AA's and few, if any, major AA's, then it may be desirable to gather minor AA's into fewer major AA's. It must make tactical sense to do this, however.

-- Two-phase AA determination. First, look for terrain- supported approaches. Second, match to enemy disposition to prioritize likely use of AA's.

-- Air AA's are also important. Three types of air AA's are of interest: Airmobile force approaches, high-performance aircraft approaches, and helicopter gunship approaches.

4.2.3.2 Specific METT-T Relationships to Part Selection. A number of comments were made regarding the relationships between the METT-T factors and part selection and assembly.

- It is usually the case that if the enemy is strong relative to friendly forces, then options which fall into the BOLD category should be rejected.

-- Bold options usually involve an offensive form with a degree of risk.

-- It is not possible to classify parts as possessing or lacking boldness.

-- In this case, bold refers to assembly, and the options are different assemblages, not

different selections.

-- Exception: It may be that the enemy is so strong that only a bold option will be successful.

- Why parts.

-- Consideration of mission may dictate a series of Why parts.

-- Why parts associated with Who parts may be different than Why part for corps, but they must facilitate the corps Why part.

-- As the relative strength favors friendly forces, the destroy enemy force Why part is more feasible.

- What parts. No comments.

- How parts. Relative strength is major determinant of How parts. Of particular importance is the manner in which the different How parts change relative strengths.

-- How parts must gain the relative strength required at all points. In other words, they must implement the principles of war Mass and Economy of Force.

-- Relative strength allows elimination of a number of How parts.

- Who parts. No comments.

- Where parts. No comments.

- When parts. No comments.

4.2.4 Concept Development Knowledge.The following organizes concepts around the criteria used to develop and compare alternative Concepts.

4.2.4.1 General Evaluation Criteria. These criteria apply for all contingencies.

- Supports overall mission. This is assessment of end state provided by COA. Criteria for end state comparison are situation dependent.

- Probability of success by phase of operation. Phases are Concept dependent.

-- It is desirable to minimize the number of phases being planned.

-- In general, want to plan (can only plan) for three to four phases into future.

- Command and Control (C^2).

-- Span of control.

--- Corps.

---- Introduction of new MSC complicates span of control.

--- MSC's.

---- Potentially less effective to allocate combat resource to unit in contact than to unit not in contact. Introduces risk.

---- Allocation of combat resource more desirable if forces have worked before in similar relationship.

---- The greater the standardization of SOP's between forces the more desirable is the allocation of combat resources.

--- Span of control measures include number of subordinates as well as number and importance of tasks assigned.

-- Communications Interoperability.

-- Personalities of subordinate commanders and their compatibility with tasks assigned.

-- Form of C^2 relationships.

- Complicating Factors.

-- Task Organization changes during operation.

- Logistics.

-- Supportability of Task Organization changes.

- Flexibility.

-- Allocation of "too many" resources to a single MSC reduces flexibility and increases likelihood an accident will lead to failure of entire operation. This can become a very strong negative in further

development of a Concept.

4.2.4.2 Specialization for Planned Counterattack.
- Supports overall mission.
-- Additional criteria.
--- Accomplishment of defense objective.
--- Speed to objectives.
---- Must wargame movement force on axis to objective.
--- End Strength on objectives.
---- Must wargame movement force on axis to objective.
---- If same unit for penetration and movement then can assume remnants of entire force will get to objective.
---- If separate unit for penetration and movement then can assume only remnants of movement force will get to objective.
---- End strength deficiencies can be overcome by Task Organization changes en route to objective, but this introduces a complicating factor.
- Probability of success by phase of operation.
-- Phase 1: Movement to positions.
-- Phase 2: Penetrate enemy lines.
-- Phase 3: Movement to objectives.
-- Phase 4: Actions after seizing objective.
- Command and Control (C^2).
-- Additional Criteria.
--- Passage of Lines.
---- Should be evaluated from corps perspective as well as from executing commander perspective.
---- More difficult when corps must get directly involved with conduct of passage.
---- Separate penetrate and movement forces implies corps must: 1) control penetrate action; 2) control movement through penetration, and 3) coordinate timing of actions related to above.
---- Combined penetrate and movement tasks place control burden on force assigned tasks. This is the best way to conduct a passage of lines.
---- Separate brigade passing through division creates problems in coordination of passing efforts and control at passing points.

4.2.4.3 Specialization for Deception.
- Separate entities under corps control.
-- Facilitates creating deceptive movement patterns.
-- Facilitates creating separate communications patterns.
-- May confuse enemy identification efforts.
- Extensive allocation of combat assets to single MSC.
-- Facilitates creating image of additional MSC.
-- Facilitates creating image of additional corps.
-- May facilitate hiding uncommitted forces.

4.2.4.4 Wargaming. Wargaming is a technique that is useful in evaluating, developing and refining partially or fully developed Schemes of Maneuver.

4.2.4.4.1 Some General Rules of Engagement for Evaluating a SM
- If corps is conducting a penetration, then forecast a location at the FLOT where a

friendly division can be put against an enemy regiment (combat ratio in favor of corps at least 3:1)

- If a corps is a prepared defender, then that corps should be able to destroy an enemy force six times its own strength.
- If the corps will attack in daylight, then it is necessary to have lots of artillery and smoke.
- A daylight attack helps with passage of lines.
- An evening passage of lines without night-vision devices is very dangerous.
- No rule for meeting engagements. Although a planner will estimate the combat ratio necessary, these situations are too variable to have a general rule.
- Before wargaming any AA, the time-to-objective for corps forces is estimated (extremely important estimate). If delays are identified in wargaming process, corps must overcome them.
- Evaluation criteria include SM ability to:
  - -- Cause delay of certain units at certain locations.
  - -- Cause commitment of certain units at certain locations.
  - -- Result in primarily soft targets between location of CoA execution start and corps objective.

4.2.4.4.2 Wargaming a particular Avenue of Approach (AA) for a corps counter-attack.

- Before selecting a particular AA to wargame, corps already has terrain analysis products in area as part of original intelligence estimate. Intelligence people looked forward and to rear in area of operations.
  - -- Look for potential AA to use
    - ---Look for AA which avoids hitting enemy head on (we must project enemy locations).
    - --- Does it support fast movment?
    - --- Does it support large force (Bde forward and Bde follow-ons)?
    - --- Obstacles.
    - --- Does it meet with location where is enemy most susceptible to penetration?
    - --- Can control be maintained (does terrain support easy movement)?
    - --- Does road net flow in direction of attack?
    - --- Steps in AA Evaluation:
      - ---- G2 Planner identifies all trafficability problems (what-if process along entire route).
      - ---- G2 Planner identifies size of unit which can be kept forward and moving.
      - ---- Operator decides whether to go with current status of bridges or to add bridges.
- What-if Process:
  - -- G2 Planner gets estimate on how long it will take enemy to get to corps objectives.
  - -- Starts at corps' expected location for D+3; the assembly area.
  - -- For whole axis of advance he asks if each bridge is intact and each autobahn interchange is intact.
  - -- Do bridges support wheels or both wheels and tanks?
  - -- He gets information on escape routes for refugees (corps probably won't use these as general AA's).
  - -- Which unit will corps conduct a passage-of-lines to (unit will be no smaller than Bde)?
  - -- What size enemy force and resistance is this unit experiencing?
    - --- Has this unit suffered heavy casualties?
    - --- What is the unit doing (withdrawing, defending, ...)?
    - --- Can this unit hold what it has got or will it need to move back some?

-- What is extent of contact along entire front trace of the corps; not just location of passage point. This is used to shift all available artillery to location where passage of lines will occur.

-- What is the situation in terms of Spetznatz and partisan forces where passage of lines will occur? Used to designate a unit in corps to handle this problem.

-- What is the situation of enemy force in contact with the corps' unit?

--- Tank or MR?

--- Length of contact and strength.

--- Current commander.

--- Response times in command and control.

-- How many air sorties will corps have available. Unavailability of close-air support probably won't result in disgarding a given SM. But availability would support adopting a given SM. Close-air support increases in importance as expected enemy resistance increases.

-- In wargaming a SM, the planners won't vary the friendly force strength (after FLOT is passed) to estimate its influence on the SM. Planners will assume combat power will be sufficient to continue the corps' mission.

-- What are the corps' capabilities to keep its corridor (to rear) open. The success of a corps penetration must be followed by efforts to keep corridor behind corps open. Corridor must be held open until corps has a link-up with another corridor.

-- For passage of lines operation, corps determines what will overtax division's capabilities and will determine what corps has available to give to division to help them. Division can be overtaxed by:

--- Artillery bullets depleted.

--- Smoke depleted.

--- Fuel depleted.

4.2.4.4.3 Special Wargaming Information Requirements.

- Information Required on Enemy. This information is used to determine how well the SM forces the enemy into a desirable situation for the corps.

-- At corps level, wargaming is done on Soviet Front.

--- Corps considers when the Front would have to react.

--- Corps considers the form of the Front's reaction. Front's reactions include reallocating units to stop a threat in a particular location.

-- Which echelon Armies are attrited.

-- Composition of next Front

-- Next Front's distance from line of contact

-- Disposition of Armies in next Front

-- Activities of next Front

--- Their capability (composition, strength, and status) to resist the corps between the corps' objective and the location where the corps' new CoA will begin 3 days from now.

-- What enemy units are going to be on the objective.

-- When will we see enemy combat units on the objective

- Target engagement zones. This information is used to estimate:

-- How enemy will move from location to location.

-- When corps will need air power.

-- When enemy will be in particular locations.

-- What actions corps can take to force enemy to move in a certain direction.

- Terrain Information Required:

-- Terrain and critical terrain features along axis of advance.

-- Status of each bridge

-- Status of towns

-- This information is used to decide what strategy should be used to avoid being

delayed in reaching the objectives. Strategy options include:

— Engineer efforts

— Use alternate routes

- Logistics information required:

-- Examine friendly units to determine equipment densities.

-- Has unit been committed recently.

-- Does unit have all equipment on hand.

-- Equipment status.

-- Have all major end-items.

-- Can it move with POL.

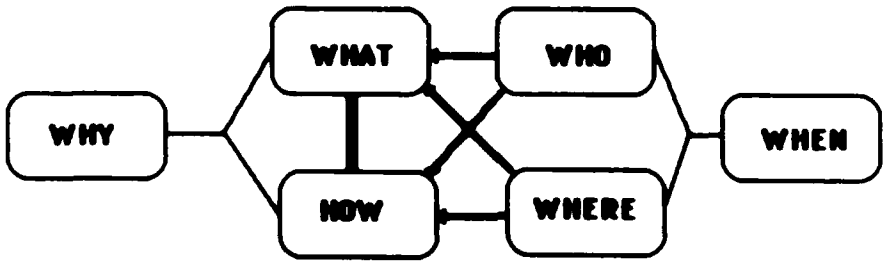
-- Can it shoot with class 5.

-- If a major shortfall exists relative to self-sustainment capability, then corps either:

— Changes concept.

— Logistician needs to get required fuel and/or ammo. (If unavailable in time required, then concept must be changed or task organization changed or switch logistics priorities from units in-contact now to the corps.

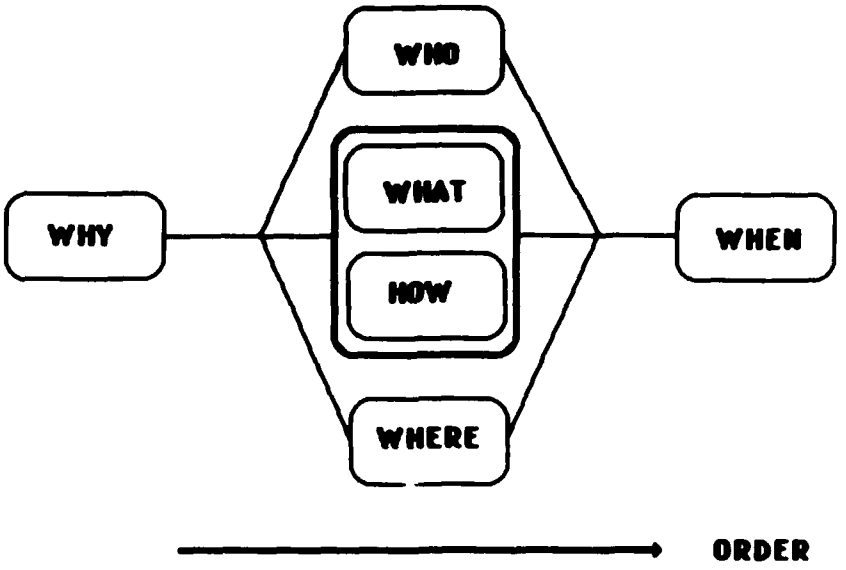
4.2.5 Category Sequence. A loose sequence exists which relates the part selection process. Almost always the Why parts are selected first. Selection of these parts will establish a framework to assist in the selection of other parts. Additionally, the selection of the Why parts may influence the sequence for selecting the remaining parts. It is common (but not always true) for the What parts and How parts to be selected next. Normally these are selected together. Again, it is common, but not always true, for the Who parts and the Where parts to be selected next. It is almost always true that the When parts are selected last. The following diagrams attempt to capture this sequence:



ORDER

POTENTIAL INTERACTION

STRONG INTERACTION



5. TASK ORGANIZATION. The following organizes concepts discussed in the session around the Task Organization portion of the Concept.

5.1 RELATIONSHIP TO C^2M.

- C^2 weak points can be overcome by Task Organization changes.

5.2 TASK ORGANIZATION CHANGES.

- As a rule of thumb a Task Organization change by corps takes 24 - 36 hours to completely effect.
  - -- ACR takes longer to chop than a brigade due to communications incompatibilities.
  - -- Logistics changeover.
    - --- Need to go through at least one log cycle.
  - -- Operational changeover easier.

5.3 FACTORS. Significant factors considered are the number of troops available, type of forces available (NOTE: The distinction between Armored and Mech is for all intents meaningless), and personalities of subordinate force commanders. As the force types become more similar, the importance of commander personalities increases. Another important point is that the corps has many assets to allocate. It normally is not necessary or desirable for the planners to break up maneuver assets into smaller pieces (for example, take a brigade away from a division) Another way to state this is that unit integrity is an important and desirable factor in allocating maneuver elements. It becomes less important in allocating non-maneuver forces.

- Unit integrity is of most concern when allocating maneuver assets. At the corps level the situation may very well dictate allocating maneuver resources of one division to another division (e.g., chopping a brigade), but in these situations the following statements are usually true.

-- The maneuver unit being allocated additional resources possesses insuficient combat power to accomplish the tasks assigned.

-- It is not desirable to allocate corps-level non-maneuver resources to the unit to make up for the

combat power shortfall (or, alternatively, the planner would first look for other, non-maneuver resources, to allocate).

– It is not desirable to allocate tasks in a different manner.

- Unit integrity is less of a factor when allocating the following types of resources: Engineers, Aviation, Air Defence, Signal, Artillery.

- TO may some times be based on the tasks allocated to the units in the TO.

6. TASK ALLOCATION. Personalities and types of forces within subordinate elements are critical factors in allocating tasks.

7. COMMAND AND CONTROL MEASURES. The following organizes concepts discussed in the session around the Command and Control Measures (C^2M) portion of the Concept.

7.1 CONTROL MEASURES.

7.1.1. Knowledge about Control Measures.

7.1.1.1 Blocking Position.

- Corps will normally establish blocking position for immediate subordinates only, if desired. Will not tell subordinate to establish position for subordinate. Example: Corps will not normally tell division to establish brigade-sized blocking position.

-- Normally give appropriate force and guidance indicating concern.

-- Task Organization changes are used to highlight these concerns.

-- An exception is when such a blocking position is crucial to win mechanism.

-- An exception exists when it is not clear who will control terrain of blocking position at time it is needed. Need to make clear that whoever occupies terrain at critical time does establish blocking position.

7.1.1.2 Boundaries.

- Boundaries are important in planning for the function they serve, which is to clearly indicate the reponsibility for specific terrain features. At a minimum, the boundaries must clearly indicate into which sector the following terrain features belong:

-- Key Terrain.

-- Avenues of Approach (AA). A basic law - Don't split an AA between units. Exception - Unless a single force is inadequate to cover an AA. This may result from a number of reasons, which include, but are not limited to, the following: the course of the AA, terrain does not provide suitable defensive positions for a single unit, other AA's in the unit's sector.

- Routes (RT). A rule of thumb - Don't split a road between units. Exception - All units need an MSR. If there is no other way to provide for an MSR then you have to split a road.

- As long as this terrain feature assignment function is satisfied, a precise definition of boundaries is not required for planning.

- Boundaries effect who controls battles.

-- Avenues of Approach effect where battles will be fought.

-- Boundary should indicate clearly who has Avenue of Approach, and thus who controls battle along Avenue of Approach. Conversely, Avenues of Approach should be allocated to subordinates.

8. SUPPORT PRIORITIES.

END

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